



**National Aeronautics and  
Space Administration  
Langley Research Center**

**Scientific and Technical  
Information Program Office**

# **Scientific and Technical Aerospace Reports**

# STAR

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## NASA STI Program ... in Profile

Since its founding, NASA has been dedicated to the advancement of aeronautics and space science. The NASA scientific and technical information (STI) program plays a key part in helping NASA maintain this important role.

The NASA STI program operates under the auspices of the Agency Chief Information Officer. It collects, organizes, provides for archiving, and disseminates NASA's STI. The NASA STI program provides access to the NASA Aeronautics and Space Database and its public interface, the NASA Technical Report Server, thus providing one of the largest collections of aeronautical and space science STI in the world. Results are published in both non-NASA channels and by NASA in the NASA STI Report Series, which includes the following report types:

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- **TECHNICAL MEMORANDUM.** Scientific and technical findings that are preliminary or of specialized interest, e.g., quick release reports, working papers, and bibliographies that contain minimal annotation. Does not contain extensive analysis.
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- **SPECIAL PUBLICATION.** Scientific, technical, or historical information from NASA programs, projects, and missions, often concerned with subjects having substantial public interest.
- **TECHNICAL TRANSLATION.** English-language translations of foreign scientific and technical material pertinent to NASA's mission.

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- E-mail your question via the Internet to [help@sti.nasa.gov](mailto:help@sti.nasa.gov)
- Fax your question to the NASA STI Help Desk at 443-757-5803
- Phone the NASA STI Help Desk at 443-757-5802
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NASA STI Help Desk  
NASA Center for AeroSpace Information  
7115 Standard Drive  
Hanover, MD 21076-1320

# Introduction

*Scientific and Technical Aerospace Reports (STAR)* is an online information resource listing citations and abstracts of NASA and worldwide aerospace-related scientific and technical information (STI). Updated biweekly, *STAR* highlights the most recent additions to the NASA Aeronautics and Space Database. Through this resource, the NASA STI Program provides timely access to the most current aerospace-related research and development (R&D) results.

*STAR* subject coverage includes all aspects of aeronautics and space research and development, supporting basic and applied research, and application, as well as aerospace aspects of Earth resources, energy development, conservation, oceanography, environmental protection, urban transportation and other topics of high national priority. The listing is arranged first by 11 broad subject divisions, then within these divisions by 76 subject categories and includes two indexes: subject and author.

*STAR* includes citations to R&D results reported in:

- NASA, NASA contractor, and NASA grantee reports
- Reports issued by other U.S. Government agencies, domestic and foreign institution, universities, and private firms
- Translations
- NASA-owned patents and patent applications
- Other U.S. Government agency and foreign patents and patent applications
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## The NASA STI Program

The NASA STI Program was established to support the objectives of NASA's missions and research to advance aeronautics and space science. By sharing information, the NASA STI Program ensures that the U.S. maintains its preeminence in aerospace-related industries and education, minimizes duplication of research, and increases research productivity.

Through the NASA Center for AeroSpace Information (CASI), the NASA STI Program acquires, processes, archives, announces, and disseminates both NASA's internal STI and worldwide STI. The results of 20th and 21st century aeronautics and aerospace research and development, a worldwide investment totaling billions of dollars, have been captured, organized, and stored in the NASA Aeronautics and Space Database. New information is continually announced and made available as it is acquired, making this a dynamic and historical collection of value to business, industry, academia, federal institutions, and the general public.

The STI Program offers products and tools that allow efficient access to the wealth of information derived from global R&D efforts. In addition, customized services are available to help tailor this valuable resource to meet your specific needs.

For more information on the most up-to-date NASA STI, visit the STI Program's Web site at <http://www.sti.nasa.gov>.

# NASA STI Availability Information

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Through NASA CASI, the NASA STI Program offers many information products and services to the aerospace community and to the public, including access to a selection of full text of the NASA STI. Free registration with the program is available to NASA, U.S. Government agencies and contractors. To register, contact CASI at [help@sti.nasa.gov](mailto:help@sti.nasa.gov). Others should visit the program at [www.sti.nasa.gov](http://www.sti.nasa.gov). The 'search selected databases' button provides access to the NASA Technical Reports Server (NTRS) – the publicly available contents of the NASA Aeronautics and Space Database.

Each citation in *STAR* indicates a 'Source of Availability.' When CASI is indicated, the user can order this information directly from CASI using the [STI Online Order Form](#), e-mail to [help@sti.nasa.gov](mailto:help@sti.nasa.gov), or telephone the STI Help Desk at 443-757-5802. Before ordering you may access [price code tables](#) for STI documents and videos. When information is not available from CASI, the source of the information is indicated when known.

NASA STI is also available to the public through Federal information organizations. NASA CASI disseminates publicly available NASA STI to the National Technical Information Service (NTIS) and to the Federal Depository Library Program (FDLP) through the Government Printing Office (GPO). In addition, NASA patents are available online from the U.S. Patent and Trademark Office.

## National Technical Information Service (NTIS)

The National Technical Information Service serves the American public as a central resource for unlimited, unclassified U.S. Government scientific, technical, engineering, and business related information. For more than 50 years NTIS has provided businesses, universities, and the public timely access to well over 2 million publications covering over 350 subject areas. Visit NTIS at <http://www.ntis.gov>.

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The U.S. Congress established the **Federal Depository Library Program** to ensure access for the American public to U.S. Government information. The program acquires and disseminates information products from all three branches of the U.S. Government to nearly 1,300 Federal depository libraries nationwide. The libraries maintain these information products as part of their existing collections and are responsible for assuring that the public has free access to the information. Locate the Federal depository libraries at <http://www.gpoaccess.gov/index.html>.

## The U.S. Patent and Trademark Office (USPTO)

The U.S. Patent and Trademark Office provides online access to full text patents and patent applications. The database includes patents back to 1976 plus some pre-1975 patents. Visit the USPTO at <http://www.uspto.gov/patft/>.

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Two indexes are available. You may use the find command under the tools menu while viewing the PDF file for direct match searching on any text string. You may also select either of the two indexes provided for linking to the corresponding document citation from *NASA Thesaurus* terms and personal author names.

[Subject Term Index](#)

[Personal Author Index](#)

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# SCIENTIFIC AND TECHNICAL AEROSPACE REPORTS

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## 01

### AERONAUTICS (GENERAL)

Includes general research topics related to manned and unmanned aircraft and the problems of flight within the Earth's atmosphere. Also includes manufacturing, maintenance, and repair of aircraft. For specific topics in aeronautics, see categories 02 through 09. For information related to space vehicles see 12 Astronautics.

**20090035008** Federal Aviation Administration, Washington, DC USA

#### **On-Demand Operators have Less Stringent Safety Requirements and Oversight than Large Commercial Air Carriers**

Jul. 2009; 25 pp.; In English

Report No.(s): PB2009-113657; FAA-AV-2009-066; No Copyright; Avail.: National Technical Information Service (NTIS)

On-demand operators have more risk in their operating environments and receive less oversight from FAA. For example, one on-demand operator we visited flew dozens of flights daily during the summer to take tourists to glaciers on which the aircraft landed and took off on skis. This operator flies 17 aircraft and was inspected 8 times by FAA in 2008. In contrast, a Part 121 operator with 10 aircraft, overseen by the same FAA oversight office, received 199 inspections in 2008. Industry and the National Transportation Safety Board (NTSB) have made recommendations to strengthen on-demand regulations. While FAA has made efforts to improve safety and adapt its oversight to the increased complexity of industry operations, it has not taken substantive action to address these recommendations. Further, FAA does not effectively target inspections to higher-risk on-demand operators. The number of fatalities from on-demand operations makes it imperative that FAA take action to address three issues we identified as it plans regulatory and oversight changes for the growing on-demand operator industry.

NTIS

*Aircraft Industry; Commercial Aircraft; Risk; Safety*

## 03

### AIR TRANSPORTATION AND SAFETY

Includes passenger and cargo air transport operations; airport ground operations; flight safety and hazards; and aircraft accidents. Systems and hardware specific to ground operations of aircraft and to airport construction are covered in 09 Research and Support Facilities (Air). Air traffic control is covered in 04 Aircraft Communications and Navigation. For related information see also 16 Space Transportation and Safety and 85 Technology Utilization and Surface Transportation.

**20090034957** NTI, Inc., Fairborn, OH USA

#### **24/7 Operational Effectiveness Toolset: Mission Scheduler Interface**

Eddy, Douglas R; Moise, Jr, Samuel L; Miller, James C; Welch, Cory; Nov 18, 2008; 59 pp.; In English; Original contains color illustrations

Contract(s)/Grant(s): FA8650-06-C-6606; Proj-5020

Report No.(s): AD-A505138; No Copyright; Avail.: Defense Technical Information Center (DTIC)

While the objective of every aircrew is to accomplish their mission, every effort must be made to ensure the safety of the crew. Air Force Air Mobility Command (AMC) has been flying more and longer missions with fewer pilots and fatigue has become a potential safety issue. Safety is compromised when aircrews are performing their mission tasks in a fatigued state. A fatigue assessment and management tool built on a scientifically based model of sleep and cognitive performance can be helpful in managing the fatigue problem. The purpose of this report is to document a portion of the work conducted under a Phase 3 SBIR contract to develop a web-based, fatigue management tool with interfaces for diverse user applications. The Fatigue-Performance Assessment System (F-PAS) was derived from the Fatigue, Avoidance Scheduling Tool (FAST(TM)), which contains the Sleep, Activity, Fatigue, and Task Effectiveness (SAFTE) model that forecasts cognitive performance level based on sleep, circadian rhythm, and sleep inertia. Specifically, this report describes the Mission Scheduler Interface of the



24/7 Operational Toolset to be used by AMC schedulers, pilots, and flight surgeons. The interface was designed to aid in the scheduling of military missions and duty periods such that the effects of mental fatigue on human performance are minimized. Aircrew and flight surgeons can use the tool to evaluate pharmaceutical fatigue countermeasures when sufficient sleep cannot be scheduled for a critical long duration or nighttime mission. Aircrew can also use the tool to evaluate the fatigue impact of changes to an interrupted mission schedule. A task-centered, system design involving task analysis was used to develop the requirements for the interface. The report includes task descriptions, an interface description, and usability results, which revealed that the early Beta implementation of F-PAS was effective for determining fatigue effects on performance.

DTIC

*Application Programming Interface; Computer Programming; Flight Crews; Safety; Scheduling; Software Engineering; System Effectiveness*

**20090035565** Congressional Research Service, Washington, DC, USA

**Kyrgyzstan and the Status of the U.S. Manas Airbase: Context and Implications**

Nichol, J.; Jul. 01, 2009; 14 pp.; In English

Report No.(s): PB2009-113394; No Copyright; Avail.: CASI: [A03](#), Hardcopy

In February 2009, Kyrgyzstan announced that it was terminating an agreement permitting U.S. forces to upgrade and use portions of the Manas international airport near the capital of Bishkek to support coalition military operations in Afghanistan. U.S. forces faced leaving the airbase by late August 2009. Major U.S. concerns included working out alternative logistics routes and support functions for a surge in U.S. and NATO operations in Afghanistan and possibly cooler security ties with Kyrgyzstan that could set back U.S. counter-terrorism efforts and other U.S. interests in Central Asia. After reportedly intense negotiations, the USA and Kyrgyzstan reached agreement in June 2009 on modalities for maintaining U.S. and NATO transit operations at Manas.

NTIS

*Afghanistan; Airports; Armed Forces (United States); Closures; Kyrgyzstan*

**20090035766** Auburn Univ., AL, USA; Auburn Univ., AL, USA; Federal Aviation Administration, Washington, DC, USA

**Effects of Hydrogen Peroxide on Common Aviation Textiles**

Chou, S. F.; Overfelt, R. A.; Gale, R. A.; Gale, W. F.; Shannon, H. S.; Buschle-Diller, C. G.; Watson, J.; August 2009; 28 pp.; In English; Original contains black and white illustrations

Contract(s)/Grant(s): Co-Op Agrmt No. 07-C-RITE-A

Report No.(s): DOT/FAA/AM-09/16; Copyright; Avail.: CASI: [A03](#), Hardcopy

Modern transportation systems are subject to unintentional contamination from infected passengers, as well as deliberate contamination from criminals and political adversaries. Hydrogen peroxide has been used for years as a disinfectant in the medical community and is under consideration in the dilute vapor form as a decontaminant/disinfectant/sterilant for transportation vehicles like aircraft, buses, subway trains, ambulances, etc. Although the biological efficacy of STERIS Corporation's Vaporized Hydrogen Peroxide (VHP a registered trademark of the STERIS Corporation, Mentor, OH.) technology has been demonstrated elsewhere, the compatibility of the process with typical aircraft materials has not been rigorously established. The present report documents a materials compatibility evaluation involving the effects of hydrogen peroxide exposure on the mechanical properties and flammability of the following commercial-grade textile materials: wool, nylon, polyester, Nomex, and leather.

Author

*Hydrogen Peroxide; Transportation; Vaporizing; Decontamination*

**20090035818** NASA Langley Research Center, Hampton, VA, USA

**An Exploratory Study of Runway Arrival Procedures: Time Based Arrival and Self-Spacing**

Houston, Vincent E.; Barmore, Bryan; September 21, 2009; 14 pp.; In English; 9th AIAA Aviation Technology, Integration, and Operations Conference, 21-24 Sep. 2009, Hilton Head, SC, USA; Original contains color and black and white illustrations

Contract(s)/Grant(s): WBS 411931.02.61.07.01

Report No.(s): LF99-8374; No Copyright; Avail.: CASI: [A03](#), Hardcopy

ONLINE: <http://hdl.handle.net/2060/20090035818>

The ability of a flight crew to deliver their aircraft to its arrival runway on time is important to the overall efficiency of the National Airspace System (NAS). Over the past several years, the NAS has been stressed almost to its limits resulting in problems such as airport congestion, flight delay, and flight cancellation to reach levels that have never been seen before in



the NAS. It is predicted that this situation will worsen by the year 2025, due to an anticipated increase in air traffic operations to one-and-a-half to three times its current level. Improved arrival efficiency, in terms of both capacity and environmental impact, is an important part of improving NAS operations. One way to improve the arrival performance of an aircraft is to enable the flight crew to precisely deliver their aircraft to a specified point at either a specified time or specified interval relative to another aircraft. This gives the flight crew more control to make the necessary adjustments to their aircraft's performance with less tactical control from the controller; it may also decrease the controller's workload. Two approaches to precise time navigation have been proposed: Time-Based Arrivals (e.g., required times of arrival) and Self-Spacing. Time-Based Arrivals make use of an aircraft's Flight Management System (FMS) to deliver the aircraft to the runway threshold at a given time. Self-Spacing enables the flight crew to achieve an ATC assigned spacing goals at the runway threshold relative to another aircraft. The Joint Planning and Development Office (JPDO), a multi-agency initiative established to plan and coordinate the development of the Next Generation Air Transportation System (NextGen), has asked for data for both of these concepts to facilitate future research and development. This paper provides a first look at the delivery performance of these two concepts under various initial and environmental conditions in an air traffic simulation environment.

Author

*Air Traffic Control; National Airspace System; Flight Management Systems; Flight Crews; Runways; Air Transportation; Management Planning*

**20090035823** NASA Ames Research Center, Moffett Field, CA, USA

**A Mixed Integer Linear Program for Airport Departure Scheduling**

Gupta, Gautam; Jung, Yoon Chul; September 21, 2009; 1 pp.; In English; AIAA 9th Aviation Technology, Integration, and Operations, 21-23 Sep. 2009, Hilton Head, SC, USA

Contract(s)/Grant(s): WBS 30529510

Report No.(s): ARC-E-DAA-TN365; Copyright; Avail.: CASI: [A01](#), Hardcopy

ONLINE: <http://hdl.handle.net/2060/20090035823>

Aircraft departing from an airport are subject to numerous constraints while scheduling departure times. These constraints include wake-separation constraints for successive departures, miles-in-trail separation for aircraft bound for the same departure fixes, and time-window or prioritization constraints for individual flights. Besides these, emissions as well as increased fuel consumption due to inefficient scheduling need to be included. Addressing all the above constraints in a single framework while allowing for resequencing of the aircraft using runway queues is critical to the implementation of the Next Generation Air Transport System (NextGen) concepts. Prior work on airport departure scheduling has addressed some of the above. However, existing methods use pre-determined runway queues, and schedule aircraft from these departure queues. The source of such pre-determined queues is not explicit, and could potentially be a subjective controller input. Determining runway queues and scheduling within the same framework would potentially result in better scheduling. This paper presents a mixed integer linear program (MILP) for the departure-scheduling problem. The program takes as input the incoming sequence of aircraft for departure from a runway, along with their earliest departure times and an optional prioritization scheme based on time-window of departure for each aircraft. The program then assigns these aircraft to the available departure queues and schedules departure times, explicitly considering wake separation and departure fix restrictions to minimize total delay for all aircraft. The approach is generalized and can be used in a variety of situations, and allows for aircraft prioritization based on operational as well as environmental considerations. We present the MILP in the paper, along with benefits over the first-come-first-serve (FCFS) scheme for numerous randomized problems based on real-world settings. The MILP results in substantially reduced delays as compared to FCFS, and the magnitude of the savings depends on the queue and departure fix structure. The MILP assumes deterministic aircraft arrival times at the runway queues. However, due to taxi time uncertainty, aircraft might arrive either earlier or later than these deterministic times. Thus, to incorporate this uncertainty, we present a method for using the MILP with 'overlap discounted rolling planning horizon'. The approach is based on valuing near-term decision results more than future ones. We develop a model of taxi time uncertainty based on real-world data, and then compare the baseline FCFS delays with delays using the above MILP in a simple rolling-horizon method and in the overlap discounted scheme.

Author

*Integers; Airports; Scheduling; Controllers; Air Transportation; Runways*

**20090035824** California Univ., CA, USA

**Effect of Surface Traffic Count on Taxi Time at Dallas-Fort Worth (DFW) International Airport**

Kistler, Matthew Stephen; Gupta, Gautam; January 23, 2008; 2 pp.; In English; 9th AIAA Aviation Technology, Integration, and Operations, 21-23 Sep. 2009, Hilton Head, SC, USA

Contract(s)/Grant(s): WBS 30529510

Report No.(s): ARC-E-DAA-TN286; Copyright; Avail.: Other Sources; Abstract Only

As the amount of air traffic increases over the years, most airports simply do not have the means of expanding to handle the intensified traffic on the surface that will ensue. Precise surveillance equipment and automation concepts, as well as advanced surface traffic algorithms are being developed to improve airport efficiency. These surface algorithms require inputs unique to each airport to ensure maximum efficiency, and minimal taxi delay. This study analyzes surface traffic at Dallas-Fort Worth International Airport (DFW) to determine the effect of the number of aircraft on the surface and the amount of stop and go situations they experience to the amount of additional taxi time encountered. If the surface capacity of an airport is known, minimal delay can be accomplished by limiting the number of taxiing aircraft to that capacity. This concept is related to highways, where traffic flow drastically decreases as more cars occupy the road. An attempt to minimize this effect on highways is seen with the use of metering lights at freeway on-ramps. Since the surface traffic at airports is highly regulated, and aircraft are less mobile on the ground, limiting the surface count to a certain number can greatly reduce the amount of additional taxi time encountered, as well as reduce hazardous emissions. This study will also find the regions of an airport that encounter the most additional taxi time when the number of aircraft in that area is increased. This could help surface traffic algorithms avoid congesting that area, or re-route aircraft to different runways when that area reaches its capacity. The relationship between the amount of stop and go situations an aircraft encounters and their effect on the taxi time of that aircraft will also be investigated. This will help to determine the effect of holding an aircraft on the taxiway as opposed to re-routing it. The lesser of the two should be used when developing surface traffic algorithms to further minimize the delay encountered. The fields investigated in this study include taxi time, the number of aircraft on the surface, the number of stop and go situations, and the time stopped for each aircraft. Taxi time is defined as spot to runway for departures, and runway to spot for arrivals. It does not include ramp area taxi time because the ramp area is controlled differently, and surface traffic schedulers do not currently incorporate them. Taxi time is found by finding the difference between take-off time (OFF) and spot crossing time for departures, and spot crossing time and landing time (ON) for arrivals. All surface data was either found directly using the Surface Operations Data Analysis and Adaptation (SODAA), a tool to analyze the Surface Management System (SMS) generated log files, or indirectly from SODAA using Matlab to derive values from SODAA data. The number of aircraft on the surface is found by looping through the ON times, OFF times, and spot times for each aircraft during a particular day. For each departure aircraft, surface counts are taken at its spot crossing and OFF time. The average of these two is used as the surface count for that aircraft. For arrivals, surface counts are taken at its ON time and its spot crossing time. The average of these two is used.

Author

*Air Traffic; Control Surfaces; Routes; Runways; Surveillance; Scheduling; Airports; Taxiing; Takeoff*

**20090035831** California Univ., Santa Cruz, CA, USA

**Design Analysis of Corridors-in-the-Sky**

Xue, Min; August 10, 2008; 11 pp.; In English; Guidance, Navigation, and control Conference (GN&C) 2009, 10-13 Aug. 2009, Chicago, IL, USA; Original contains color and black and white illustrations

Report No.(s): ARC-E-DAA-TN381; Copyright; Avail.: CASI: [A03](#), Hardcopy

ONLINE: <http://hdl.handle.net/2060/20090035831>

Corridors-in-the-sky or tubes is one of new concepts in dynamic airspace configuration. It accommodates high density traffic, which has similar trajectories. Less air traffic controllers workload is expected than classic airspaces, thus, corridors-in-the-sky may increase national airspace capacity and reduce flight delays. To design corridors-in-the-sky, besides identifying their locations, their utilization, altitudes, and impacts on remaining system need to be analyzed. This paper chooses one tube candidate and presents analyses of spatial and temporal utilization of the tube, the impact on the remaining traffic, and the potential benefit caused by off-loading the traffic from underlying sectors. Fundamental issues regarding the benefits have been also clarified. Methods developed to assist the analysis are described. Analysis results suggest dynamic tubes in terms of varied utilizations during different time periods. And it is found that combined lane options would be a good choice to lower the impact on non-tube users. Finally, it shows significant reduction of peak aircraft count in underlying sectors with only one tube enabled.

Author

*Airspace; Position (Location); Air Traffic Controllers (Personnel); Design Analysis; Trajectories; Air Traffic*

**20090036284** Air Force Research Lab., Mesa, AZ USA

**Fight's On! Newsletter, Volume 8, Issue 1, Spring 2009**

Cinardo, Gina; Spring 2009; 5 pp.; In English; Original contains color illustrations

Contract(s)/Grant(s): FA8650-05-D-6502; Proj-1123; 62202F

Report No.(s): AD-A504678; AFRL-RH-AZ-NL-2009-0001; No Copyright; Avail.: Defense Technical Information Center (DTIC)

ONLINE: <http://hdl.handle.net/100.2/ADA504678>

Newsletter contains the following articles: Stephens, S., Rehearsal Enabling Simulation Technologies Team Contributions; Rowe, L., Research Explorations: Quantifying Live and Virtual Training Needs for Operational Implementation; Crane, P., Cooperative Research Project Helps Swedish Air Force (SwAF) Prepare for Red Flag; Kleinlein, B., Testbed Upgrade for Helmet-Mounted Cueing System; Symons, S., Dynamic Motion Seat Undergoes Fidelity Assessment and Tactical Enhancement Study; Barrera, K., & Rickard, R., 711 HPW/RHA Technology Incorporated into Boeing Project Alpine II Demo; and Barrera, K., & Neterer, J., USAFE, EUCOM, & PACAF, PACOM Collaboration Update.

DTIC

*Flight Simulation; Military Technology; Pilots; Research and Development*

**20090036330** Georgia Inst. of Tech., Atlanta, GA, USA

**Unmanned Aerial Vehicle Systems for Disaster Relief: Tornado Alley**

DeBusk, Wesley M.; April 06, 2009; 10 pp.; In English; AIAA Unmanned Unlimited Conference and Exhibit, 6-9 Apr. 2009, Seattle, WA; Original contains color and black and white illustrations

Report No.(s): ARC-E-DAA-TN500; Copyright; Avail.: CASI: A02, Hardcopy

ONLINE: <http://hdl.handle.net/2060/20090036330>

Unmanned aerial vehicle systems are currently in limited use for public service missions worldwide. Development of civil unmanned technology in the USA currently lags behind military unmanned technology development in part because of unresolved regulatory and technological issues. Civil unmanned aerial vehicle systems have potential to augment disaster relief and emergency response efforts. Optimal design of aerial systems for such applications will lead to unmanned vehicles which provide maximum potentiality for relief and emergency response while accounting for public safety concerns and regulatory requirements. A case study is presented that demonstrates application of a civil unmanned system to a disaster relief mission with the intent on saving lives. The concept utilizes unmanned aircraft to obtain advanced warning and damage assessments for tornados and severe thunderstorms. Overview of a tornado watch mission architecture as well as commentary on risk, cost, need for, and design tradeoffs for unmanned aerial systems are provided.

Author

*Pilotless Aircraft; Military Technology; Damage Assessment; Disasters; Emergencies; Safety; Risk*

## 04

### AIRCRAFT COMMUNICATIONS AND NAVIGATION

Includes all modes of communication with and between aircraft; air navigation systems (satellite and ground based); and air traffic control. For related information see also 06 Avionics and Aircraft Instrumentation; 17 Space Communications, Spacecraft Communications, Command and Tracking; and 32 Communications and Radar.

**20090035904** California Inst. of Tech., Pasadena, CA, USA

**Multi-Cone Model for Estimating GPS Ionospheric Delays**

Sparks, Lawrence; Komjathy, Attila; Mannucci, Anthony; NASA Tech Briefs, October 2009; October 2009, pp. 24-25; In English; See also [20090035873](#); Original contains color illustrations

Report No.(s): NPO-40931; Copyright; Avail.: CASI: A01, Hardcopy

ONLINE: <http://hdl.handle.net/2060/20090035904>; <http://www.techbriefs.com/component/content/article/5786>

The multi-cone model is a computational model for estimating ionospheric delays of Global Positioning System (GPS) signals. It is a direct descendant of the conical-domain model. A primary motivation for the development of this model is the need to find alternatives for modeling slant delays at low latitudes, where ionospheric behavior poses an acute challenge for GPS signal-delay estimates based upon the thin-shell model of the ionosphere.

Derived from text

*Global Positioning System; Signal Distortion; Earth Ionosphere; Models*

## AIRCRAFT DESIGN, TESTING AND PERFORMANCE

Includes all stages of design of aircraft and aircraft structures and systems. Also includes aircraft testing, performance and evaluation, and aircraft and flight simulation technology. For related information see also 18 Spacecraft Design, Testing and Performance and 39 Structural Mechanics. For land transportation vehicles see 85 Technology Utilization and Surface Transportation.

**20090034898** Air Force Inst. of Tech., Wright-Patterson AFB, OH USA

### **Reengineering the Tanker Allocation Process**

Trinklein, Allison M; Jun 2009; 78 pp.; In English; Original contains color illustrations

Report No.(s): AD-A505134; AFIT/IMO/ENS/09-15; No Copyright; Avail.: Defense Technical Information Center (DTIC)

This research explores the need to reengineer the tanker allocation process at the Tanker Airlift Control Center using a 4 round Delphi study consisting of 22 subject matter experts throughout Air Mobility Command, Air Combat Command, the US Navy, and the US Marine Corps. The research uses business process reengineering (BPR) principles to determine the environment for reengineering, the needs of stakeholders and customers, and the underlying assumptions of current processes. The Delphi study reveals that current climate favors BPR, and a centralized process with visibility and optimization control for allocating tankers is in need. Several ramifications of this process are discussed.

DTIC

*Tanker Aircraft; Mobility*

**20090034953** Army Research Lab., White Sands Missile Range, NM USA

### **Automated Routing of Unmanned Aircraft Systems (UAS)**

Measure, Edward M; Knapp, David; Jameson, Terry; Butler, Andrew; Sep 2009; 46 pp.; In English; Original contains color illustrations

Report No.(s): AD-A505124; ARL-TR-4916; No Copyright; Avail.: Defense Technical Information Center (DTIC)

Unmanned Aircraft Systems (UAS) have become a key component of US military power and are likely to have an increasing role in reconnaissance, surveillance, communication and combat. UAS operations are affected by weather and other environmental effects, but usually have less capability to see, react to, and endure adverse environments than manned aircraft. Weather effects thus become a crucial part of both operational planning and execution of UAS missions. The U.S. Army Research Laboratory (ARL) has devised a weather effects tactical decision aid, which uses systems performance parameters, a weather effects database, and observed and predicted meteorological (Met) parameters to plan routes through weather and other hazards to carry out missions with maximum effectiveness and minimal mission risk.

DTIC

*Aircraft; Unmanned Aircraft Systems*

**20090035867** NASA Ames Research Center, Moffett Field, CA, USA

### **SMART Rotor Development and Wind-Tunnel Test**

Lau, Benton H.; Straub, Friedrich; Anand, V. R.; Birchette, Terry; September 14, 2009; 2 pp.; In English; 35th European Rotorcraft Forum, 22-25 Sep, 1998, Hamburg, Germany; Original contains color illustrations

Report No.(s): ARC-E-DAA-TN453; 747; Copyright; Avail.: CASI: [A01](#), Hardcopy

ONLINE: <http://hdl.handle.net/2060/20090035867>

Boeing and a team from Air Force, NASA, Army, Massachusetts Institute of Technology, University of California at Los Angeles, and University of Maryland have successfully completed a wind-tunnel test of the smart material actuated rotor technology (SMART) rotor in the 40- by 80-foot wind-tunnel of the National Full-Scale Aerodynamic Complex at NASA Ames Research Center, figure 1. The SMART rotor is a full-scale, five-bladed bearingless MD 900 helicopter rotor modified with a piezoelectric-actuated trailing-edge flap on each blade. The development effort included design, fabrication, and component testing of the rotor blades, the trailing-edge flaps, the piezoelectric actuators, the switching power amplifiers, the actuator control system, and the data/power system. Development of the smart rotor culminated in a whirl-tower hover test which demonstrated the functionality, robustness, and required authority of the active flap system. The eleven-week wind tunnel test program evaluated the forward flight characteristics of the active-flap rotor, gathered data to validate state-of-the-art codes for rotor noise analysis, and quantified the effects of open- and closed-loop active-flap control on rotor loads, noise, and performance. The test demonstrated on-blade smart material control of flaps on a full-scale rotor for the first time in a wind tunnel. The effectiveness and the reliability of the flap actuation system were successfully demonstrated in more than 60 hours of wind-tunnel testing. The data acquired and lessons learned will be instrumental in maturing this technology and

transitioning it into production. The development effort, test hardware, wind-tunnel test program, and test results will be presented in the full paper.

Author

*Bearingless Rotors; Rotary Wings; Rotor Aerodynamics; Smart Materials; Horizontal Flight; Flight Characteristics; Active Control; Feedback Control*

**20090035908** Air Force Research Lab., Wright-Patterson AFB, OH USA

#### **Aircraft Thermal Management Using Loop Heat Pipes**

Fleming, Andrew J.; Thomas, Scott K.; Yerkes, Kirk L.; Leland, Quinn H.; March 2009; 155 pp.; In English; Original contains color and black and white illustrations

Contract(s)/Grant(s): Proj-3145; 62203F

Report No.(s): AD-A504619; AFRL-RZ-WP-TP-2009-2107; No Copyright; Avail.: Defense Technical Information Center (DTIC)

ONLINE: <http://hdl.handle.net/100.2/ADA504619>

The objective of this thesis was to determine the feasibility of using loop heat pipes to dissipate waste heat from power electronics to the skin of a fighter aircraft and examine the performance characteristics of a titanium-water loop heat pipe under stationary and elevated acceleration fields. In the past, it has been found that the boundary condition at the condenser can be a controlling factor in the overall performance of this type of thermal management scheme. Therefore, the heat transfer removed from the aircraft skin has been determined by modeling the wing as a flat plate at zero incidence as a function of the following parameters: airspeed: 0.8 /\_ Ma infinity /- 1.4; altitude: 0 /- H/- 22 km; wall temperature: 105 /- Tw/-135 degrees C. In addition, the effects of the variable properties of air have been taken into account. Heat transfer due to thermal radiation has been neglected in this analysis due to the low skin temperatures and high airspeeds up to Ma infinity = 1.4. It was observed that flight speed and altitude have a significant effect on the heat transfer abilities from the skin to ambient, with heat rejection becoming more difficult with increasing Mach number or decreasing altitude. An experiment has been developed to examine operating characteristics of a titanium-water loop heat pipe (LHP) under stationary and elevated acceleration fields. The LHP was mounted on a 2.44 m diameter centrifuge table on edge with heat applied to the evaporator via a mica heater and heat rejected using a high-temperature polyalphaolefin coolant loop.

DTIC

*Fighter Aircraft; Heat Pipes; Temperature Control*

## **06**

### **AVIONICS AND AIRCRAFT INSTRUMENTATION**

Includes all avionics systems, cockpit and cabin display devices, and flight instruments intended for use in aircraft. For related information see also 04 Aircraft Communications and Navigation; 08 Aircraft Stability and Control; 19 Spacecraft Instrumentation and Astrionics; and 35 Instrumentation and Photography.

**20090035799** NASA Johnson Space Center, Houston, TX, USA

#### **Avionics System Architecture for the NASA Orion Vehicle**

Baggerman, Clint; McCabe, Mary; Verma, Dinesh; November 11, 2009; 10 pp.; In English; SAE AeroTech Congress and Exhibition, 10-12 Nov. 2009, Seattle, WA, USA; Original contains color and black and white illustrations

Report No.(s): JSC-CN-18906; 09ATC-0118; Copyright; Avail.: Other Sources

It has been 30 years since the National Aeronautics and Space Administration (NASA) last developed a crewed spacecraft capable of launch, on-orbit operations, and landing. During that time, aerospace avionics technologies have greatly advanced in capability, and these technologies have enabled integrated avionics architectures for aerospace applications. The inception of NASA's Orion Crew Exploration Vehicle (CEV) spacecraft offers the opportunity to leverage the latest integrated avionics technologies into crewed space vehicle architecture. The outstanding question is to what extent to implement these advances in avionics while still meeting the unique crewed spaceflight requirements for safety, reliability and maintainability. Historically, aircraft and spacecraft have very similar avionics requirements. Both aircraft and spacecraft must have high reliability. They also must have as much computing power as possible and provide low latency between user control and effector response while minimizing weight, volume, and power. However, there are several key differences between aircraft and spacecraft avionics. Typically, the overall spacecraft operational time is much shorter than aircraft operation time, but the typical mission time (and hence, the time between preventive maintenance) is longer for a spacecraft than an aircraft. Also, the radiation environment is typically more severe for spacecraft than aircraft. A 'loss of mission' scenario (i.e. - the mission



is not a success, but there are no casualties) arguably has a greater impact on a multi-million dollar spaceflight mission than a typical commercial flight. Such differences need to be weighted when determining if an aircraft-like integrated modular avionics (IMA) system is suitable for a crewed spacecraft. This paper will explore the preliminary design process of the Orion vehicle avionics system by first identifying the Orion driving requirements and the difference between Orion requirements and those of other previous crewed spacecraft avionics systems. Common systems engineering methods will be used to evaluate the value propositions, or the factors that weight most heavily in design consideration, of Orion and other aerospace systems. Then, the current Orion avionics architecture will be presented and evaluated.

Author

*Aerospace Systems; Avionics; Safety; Reliability; Preventive Maintenance; Spacecraft Launching; Systems Engineering; Systems Integration*

## 08

### AIRCRAFT STABILITY AND CONTROL

Includes flight dynamics, aircraft handling qualities, piloting, flight controls, and autopilots. For related information see also 05 Aircraft Design, Testing and Performance; and 06 Avionics and Aircraft Instrumentation.

**20090036314** NASA Ames Research Center, Moffett Field, CA, USA

#### **Robust Optimal Adaptive Control Method with Large Adaptive Gain**

Nguyen, Nhan T.; April 06, 2009; 20 pp.; In English; AIAA Infotech\@Aerospace, 6-9 Apr. 2009, Seattle, WA, USA; Original contains black and white illustrations

Contract(s)/Grant(s): WBS 457280.02.07.01.02.01

Report No.(s): ARC-E-DAA-TN536; No Copyright; Avail.: CASI: [A03](#), Hardcopy

ONLINE: <http://hdl.handle.net/2060/20090036314>

In the presence of large uncertainties, a control system needs to be able to adapt rapidly to regain performance. Fast adaptation is referred to the implementation of adaptive control with a large adaptive gain to reduce the tracking error rapidly. However, a large adaptive gain can lead to high-frequency oscillations which can adversely affect robustness of an adaptive control law. A new adaptive control modification is presented that can achieve robust adaptation with a large adaptive gain without incurring high-frequency oscillations as with the standard model-reference adaptive control. The modification is based on the minimization of the Y2 norm of the tracking error, which is formulated as an optimal control problem. The optimality condition is used to derive the modification using the gradient method. The optimal control modification results in a stable adaptation and allows a large adaptive gain to be used for better tracking while providing sufficient stability robustness. Simulations were conducted for a damaged generic transport aircraft with both standard adaptive control and the adaptive optimal control modification technique. The results demonstrate the effectiveness of the proposed modification in tracking a reference model while maintaining a sufficient time delay margin.

Author

*Adaptive Control; Robustness (Mathematics); Model Reference Adaptive Control; Optimal Control; Oscillations; Gradients; Stability*

## 14

### GROUND SUPPORT SYSTEMS AND FACILITIES (SPACE)

Includes launch complexes, research and production facilities; ground support equipment, e.g., mobile transporters; and test chambers and simulators. Also includes extraterrestrial bases and supporting equipment. For related information see also *09 Research and Support Facilities (Air)*.

**20090035740** Jet Propulsion Lab., California Inst. of Tech., Pasadena, CA, USA

#### **The Interim: Until You Achieve an Operationally Responsive Ground System**

Wendlandt, Bob; Clarke, Kelly; Miyamoto, Charles; Lei, Jordan; Owen-Mankovich, Kyran; April 1, 2008; 10 pp.; In English; Ground System Architectures Workshop Conference, 1 Apr. 2008, Redondo Beach, CA, USA; Original contains color illustrations; Copyright; Avail.: Other Sources

ONLINE: <http://hdl.handle.net/2014/41391>

Everyone wants to achieve a 'Responsive' Ground Data System (GDS), but that takes time. What do you do in the interim? Our group, called the Integration, Test and Deployment Team (ITD), is a group of responsive engineers whose primary focus is to assist JPL projects to successfully adapt, test, integrate and deploy their ground data system. The team

configures and adapts the GDS for a project, so that analysts, engineers and scientist do not need to be experts in the GDS to operate it. The team has developed a human interface to accommodate all types of users. It provides Graphical User Interfaces (GUI's) for those that want GUI's, command line interfaces for those that want control, and selection button interfaces for other users. The cornerstone of a responsive Ground Data System is responsive people. Without individuals who can be aware of a project's changing needs and requirements, how can the GDS become responsive?.

Author

*Data Systems; Ground Tests; Deployment; Data Acquisition; Graphical User Interface*

**20090035795** Jet Propulsion Lab., California Inst. of Tech., Pasadena, CA, USA

**The Interim : until you achieve an operationally responsive ground system**

Wendlandt, Bob; Clarke, Kelly; Lei, Jordan; Miyamoto, Charles; Owen-Mankovich, Kyran; April 1, 2008; 15 pp.; In English; Twelfth Annual Ground System Architectures Workshop, 1 Apr. 2008, Redondo Beach, CA, USA; Original contains color illustrations; Copyright; Avail.: Other Sources

ONLINE: <http://hdl.handle.net/2014/41390>

Everyone wants to achieve a 'Responsive' Ground Data System (GDS), but that takes time. What do you do in the interim? Our group, called the Integration, Test and Deployment Team (ITD), is a group of responsive engineers whose primary focus is to assist JPL projects to successfully adapt, test, integrate and deploy their ground data system. The team configures and adapts the GDS for a project, so that analysts, engineers and scientist do not need to be experts in the GDS to operate it. The team has developed a human interface to accommodate all types of users. It provides Graphical User Interfaces (GUI's) for those that want GUI's, command line interfaces for those that want control, and selection button interfaces for other users. The cornerstone of a responsive Ground Data System is responsive people. Without individuals who can be aware of a project's changing needs and requirements, how can the GDS become responsive

Author

*Data Acquisition; Data Systems; Graphical User Interface*

## 15

### LAUNCH VEHICLES AND LAUNCH OPERATIONS

Includes all classes of launch vehicles, launch/space vehicle systems, and boosters; and launch operations. For related information see also *18 Spacecraft Design, Testing and Performance*; and *20 Spacecraft Propulsion and Power*.

**20090035792** NASA Marshall Space Flight Center, Huntsville, AL, USA

**Constellation Launch Vehicles Overview**

Cook, Steve; Fragola, Joseph R.; Priskos, Alex; Davis, Danny; Kaynard, Mike; Hutt, John; Davis, Stephan; Creech, Steve; July 29, 2009; In English; Human Space Flight Review, 29 Jul. 2009, Huntsville, AL, USA; Original contains color illustrations; CD-ROM contains full text document in PDF format; Copyright; Avail.: CASI: **C02**, CD-ROM

This slide presentation reviews the current status of the launch vehicles associated with the Constellation Program. These are the Ares I and the Ares V. An overview of the Ares launch vehicles is included. The presentation stresses that the major criteria for the Ares I launcher is the safety of the crew, and the presentation reviews the various features that are designed to assure that aim. The Ares I vehicle is being built on a foundation of proven technologies, and the Ares V will give NASA unprecedented performance and payload volume that can enable a range of future missions. The CDs contain videos of scenes from various activities surrounding the design, construction and testing of the vehicles.

CASI

*Ares I Launch Vehicle; Ares 5 Cargo Launch Vehicle; Constellation Program; Launchers*



## SPACE TRANSPORTATION AND SAFETY

Includes passenger and cargo space transportation, e.g., shuttle operations; and space rescue techniques. For related information see also *03 Air Transportation and Safety*; *15 Launch Vehicles and Launch Operations*; and *18 Spacecraft Design, Testing and Performance*. For space suits see *54 Man/System Technology and Life Support*.

**20090036308** NASA White Sands Test Facility, NM, USA

### **Applicability of Aerospace Materials Ground Flammability Test Data to Spacecraft Environments Theory and Applied Technologies**

Hirsch, David; Williams, Jim; Beeson, Harold; October 07, 2009; 11 pp.; In English; Technical Interchange Meeting on Aerospace Materials Flammability, 7-10 Oct. 2009, Bremen, Germany; Original contains color and black and white illustrations

Report No.(s): JSC-CN-18810; No Copyright; Avail.: CASI: [A03](#), Hardcopy

ONLINE: <http://hdl.handle.net/2060/20090036308>

This slide presentation reviews the use of ground test data in reference to flammability to spacecraft environments. It reviews the current approach to spacecraft fire safety, the challenges to fire safety that the Constellation program poses, the current trends in the evaluation of the Constellation materials flammability, and the correlation of test data from ground flammability tests with the spacecraft environment. Included is a proposal for testing and the design of experiments to test the flammability of materials under similar spacecraft conditions.

CASI

*Constellation Program; Flammability; Ground Tests; Spacecraft Construction Materials; Flame Propagation; Aerospace Safety*

## SPACE COMMUNICATIONS, SPACECRAFT COMMUNICATIONS, COMMAND AND TRACKING

Includes space systems telemetry; space communications networks; astronavigation and guidance; and spacecraft radio blackout. For related information see also *04 Aircraft Communications and Navigation*; and *32 Communications and Radar*.

**20090036321** NASA Johnson Space Center, Houston, TX, USA

### **Orion Integrated Guidance, Navigation, and Control [GN and C]**

Chevray, Kay; October 2009; 11 pp.; In English; Aerospace Control and Guidance Systems Committee, 14-16 Oct. 2009, Charlottesville, VA, USA; Original contains color illustrations

Contract(s)/Grant(s): 644423.02.36.15.10

Report No.(s): JSC-CN-18944; No Copyright; Avail.: CASI: [A03](#), Hardcopy

ONLINE: <http://hdl.handle.net/2060/20090036321>

This slide presentation reviews the integrated Guidance, Navigation and Control (iGN&C) system in the design for the Orion spacecraft. Included in the review are the plans for the design and development of the external interfaces, the functional architecture, the iGN&C software, the development and validation process, and the key challenges that are involved in the development of the iGN&C system

CASI

*Control Systems Design; Crew Exploration Vehicle; Systems Integration; Spacecraft Guidance; Space Navigation*

## SPACECRAFT DESIGN, TESTING AND PERFORMANCE

Includes satellites; space platforms; space stations; spacecraft systems and components such as thermal and environmental controls; and spacecraft control and stability characteristics. For life support systems see *54 Man/System Technology and Life Support*. For related information see also *05 Aircraft Design, Testing and Performance*; *39 Structural Mechanics*; and *16 Space Transportation and Safety*.

**20090035796** Jet Propulsion Lab., California Inst. of Tech., Pasadena, CA, USA

### **JPL Advanced Thermal Control Technology Roadmap - 2008**

Birur, Gaj; March 11, 2008; 35 pp.; In English; 2008 Spacecraft Thermal Control Workshop, 11-13 Mar, 2008, El Segundo, CA, USA; Original contains color and black and white illustrations; Copyright; Avail.: Other Sources

ONLINE: <http://hdl.handle.net/2014/41389>

This slide presentation reviews the status of thermal control technology at JPL and NASA. It shows the active spacecraft

that are in various positions in the solar system, and beyond the solar system and the future missions that are under development. It then describes the challenges that the past missions posed with the thermal control systems. The various solutions that were implemented during the decades prior to 1990 are outlined. A review of the thermal challenges of the future missions is also included. The exploration plan for Mars is then reviewed. The thermal challenges of the Mars Rovers are then outlined. Also the challenges of systems that would be able to be used in to explore Venus, and Titan are described. The future space telescope missions will also need thermal control technological advances. Included is a review of the thermal requirements for manned missions to the Moon. Both Active and passive technologies that have been used and will be used are reviewed. Those that are described are Mechanically Pumped Fluid Loops (MPFL), Loop Heat Pipes, an M3 Passive Cooler, Heat Switch for Space and Mars surface applications, phase change material (PCM) technology, a Gas Gap Actuator using  $ZrNiH(x)$ , the Planck Sorption Cooler (PCS), vapor compression -- Hybrid two phase loops, advanced pumps for two phase cooling loops, and heat pumps that are lightweight and energy efficient.

CASI

*Cooling; Temperature Control; Heating Equipment; Spacecraft Temperature; Onboard Equipment*

**20090035869** NASA Ames Research Center, Moffett Field, CA, USA

#### **Correlation of Smart Active Flap Rotor Loads**

Kottapalli, Sesi; Straub, Friedrich; May 27, 2009; 21 pp.; In English; American Helicopter Society 65th Annual Forum and Technology Display, 27-29 May 2009, Grapevine, TX, USA; Original contains black and white illustrations

Report No.(s): ARC-E-DAA-TN463; 748; Copyright; Avail.: Other Sources

The ability to predict SMART active trailing edge flap rotor loads is explored in this study. Full-scale wind tunnel data recently acquired in the NASA Ames 40- by 80- Foot Wind Tunnel are compared with analytical results from CAMRAD II. For the 5-bladed rotor, two high-speed forward flight cases are considered, namely, a 0 deg flap deflection case and a 5P, 2 deg flap deflection case. Overall, the correlation is reasonable, with the following exceptions: the torsion moment frequency and the chordwise bending moment are under predicted. In general, the effect of the 5P, 2 deg flap motion is captured by the analysis, though there is over prediction in the neighborhood of the 105 deg and 120 deg azimuthal locations. Changes to the flexbeam torsion stiffness are also briefly considered in this study, as this stiffness will be updated in the future. Finally, the indication is that compressibility effects are important, and this suggests that computational fluid dynamics might improve the current correlation.

Author

*Trailing Edge Flaps; Aerodynamic Loads; Compressibility Effects; Computational Fluid Dynamics; Horizontal Flight; Rotors; Stiffness; Torsion; Bending Moments*

**20090036305** Dynamic Concepts, Inc., Huntsville, AL, USA

#### **Modeling and Simulation of Variable Mass, Flexible Structures**

Tobbe, Patrick A.; Matras, Alex L.; Wilson, Heath E.; August 10, 2009; 44 pp.; In English; AIAA Modeling and Simulation Technologies Conference, 10-13 Aug. 2009, Chicago, IL, USA

Contract(s)/Grant(s): NNM06AB35T

Report No.(s): M09-0254; M09-0560; MSFC-2229; M09-0652; Copyright; Avail.: CASI: A03, Hardcopy

ONLINE: <http://hdl.handle.net/2060/20090036305>

The advent of the new Ares I launch vehicle has highlighted the need for advanced dynamic analysis tools for variable mass, flexible structures. This system is composed of interconnected flexible stages or components undergoing rapid mass depletion through the consumption of solid or liquid propellant. In addition to large rigid body configuration changes, the system simultaneously experiences elastic deformations. In most applications, the elastic deformations are compatible with linear strain-displacement relationships and are typically modeled using the assumed modes technique. The deformation of the system is approximated through the linear combination of the products of spatial shape functions and generalized time coordinates. Spatial shape functions are traditionally composed of normal mode shapes of the system or even constraint modes and static deformations derived from finite element models of the system. Equations of motion for systems undergoing coupled

large rigid body motion and elastic deformation have previously been derived through a number of techniques [1]. However, in these derivations, the mode shapes or spatial shape functions of the system components were considered constant. But with the Ares I vehicle, the structural characteristics of the system are changing with the mass of the system. Previous approaches to solving this problem involve periodic updates to the spatial shape functions or interpolation between shape functions based on system mass or elapsed mission time. These solutions often introduce misleading or even unstable numerical transients into the system. Plus, interpolation on a shape function is not intuitive. This paper presents an approach in which the shape functions are held constant and operate on the changing mass and stiffness matrices of the vehicle components. Each vehicle stage or component finite element model is broken into dry structure and propellant models. A library of propellant models is used to describe the distribution of mass in the fuel tank or Solid Rocket Booster (SRB) case for various propellant levels. Based on the mass consumed by the liquid engine or SRB, the appropriate propellant model is coupled with the dry structure model for the stage. Then using vehicle configuration data, the integrated vehicle model is assembled and operated on by the constant system shape functions. The system mode shapes and frequencies can then be computed from the resulting generalized mass and stiffness matrices for that mass configuration. The rigid body mass properties of the vehicle are derived from the integrated vehicle model. The coupling terms between the vehicle rigid body motion and elastic deformation are also updated from the constant system shape functions and the integrated vehicle model. This approach was first used to analyze variable mass spinning beams and then prototyped into a generic dynamics simulation engine. The resulting code was tested against Crew Launch Vehicle (CLV)-class problems worked in the TREETOPS simulation package and by Wilson [2]. The Ares I System Integration Laboratory (SIL) is currently being developed at the Marshall Space Flight Center (MSFC) to test vehicle avionics hardware and software in a hardware-in-the-loop (HWIL) environment and certify that the integrated system is prepared for flight. The Ares I SIL utilizes the Ares Real-Time Environment for Modeling, Integration, and Simulation (ARTEMIS) tool to simulate the launch vehicle and stimulate avionics hardware. Due to the presence of vehicle control system filters and the thrust oscillation suppression system, which are tuned to the structural characteristics of the vehicle, ARTEMIS must incorporate accurate structural models of the Ares I launch vehicle. The ARTEMIS core dynamics simulation models the highly coupled nature of the vehicle flexible body dynamics, propellant slosh, and vehicle nozzle inertia effects combined with mass and flexible body properties that vary significantly with time during the flight. All forces that act on the vehicle during flight must be simulated, including deflected engine thrust force, spatially distributed aerodynamic forces, gravity, and reaction control jet thrust forces. These forces are used to excite an integrated flexible vehicle, slosh, and nozzle dynamics model for the vehicle stack that simulates large rigid body translations and rotations along with small elastic deformations. Highly effective matrix math operations on a distributed, threaded high-performance simulation node allow ARTEMIS to retain up to 30 modes of flex for real-time simulation. Stage elements that separate from the stack during flight are propagated as independent rigid six degrees of freedom (6DOF) bodies. This paper will present the formulation of the resulting equations of motion, solutions to example problems, and describe the resulting dynamics simulation engine within ARTEMIS.

Author

*Computerized Simulation; Elastic Deformation; Launch Vehicles; Shape Functions; Rigid Structures; Systems Integration; Structural Design; Mass Distribution; Aerodynamic Forces; Flexible Bodies; Ares I Launch Vehicle*

**20090036309** NASA White Sands Test Facility, NM, USA

**Selected Lessons Learned through the ISS Design, Development, Assembly, and Operations: Applicability to International Cooperation for Standardization**

Hirsch, David B.; October 2009; 8 pp.; In English; International Organization for Standardization Technical Committee 20, SC14 on Space Systems and Operations, 22-23 Oct. 2009, Haifa, Israel

Report No.(s): JSC-CN-18879; No Copyright; Avail.: CASI: [A02](#), Hardcopy

ONLINE: <http://hdl.handle.net/2060/20090036309>

This slide presentation reviews selected lessons that were learned during the design, development, assembly and operation of the International Space Station. The critical importance of standards and common interfaces is emphasized to create a common operation environment that can lead to flexibility and adaptability.

CASI

*International Cooperation; International Space Station; Lessons Learned; Standardization; Spacecraft Design; Structural Design*

## SPACECRAFT INSTRUMENTATION AND ASTRIONICS

Includes the design, manufacture, or use of devices for the purpose of measuring, detecting, controlling, computing, recording, or processing data related to the operation of space vehicles or platforms. For related information see also *06 Avionics and Aircraft Instrumentation*; for spaceborne instruments not integral to the vehicle itself see *35 Instrumentation and Photography*; for spaceborne telescopes and other astronomical instruments see *89 Astronomy*.

**20090034988** Jet Propulsion Lab., California Inst. of Tech., Pasadena, CA, USA

### Compact Microwave Mercury Ion Clock for Space Applications

Prestage, John D.; Tu, Meirong; Chung, Sang K.; MacNeal, Paul; November 27, 2007; 7 pp.; In English; 39th Precise Time and Time Interval (PTTI) Systems and Applications Meeting, 27-29 Nov. 2007, Long Beach, CA, USA; Original contains color and black and white illustrations; Copyright; Avail.: Other Sources

ONLINE: <http://hdl.handle.net/2014/41395>

We review progress in developing a small Hg ion clock for space operation based on breadboard ion-clock physics package where Hg ions are shuttled between a quadrupole and a 16-pole rf trap. With this architecture we have demonstrated short-term stability approx.  $1-2 \times 10^{-13}$  at 1 second, averaging to 10-15 at 1 day. This development shows that H-maser quality stabilities can be produced in a small clock package, comparable in size to an ultra-stable quartz oscillator required or holding  $1-2 \times 10^{-13}$  at 1 second. We have completed an ion clock physics package designed to withstand vibration of launch and are currently building a approx. 1 kg engineering model for test. We also discuss frequency steering software algorithms that simultaneously measure ion signal size and lamp light output, useful for long term operation and self-optimization of microwave power and return engineering data.

Author

*Atmospheric Ionization; Metal Ions; Mercury (Metal); Radio Frequencies; Quartz; Autonomous Spacecraft Clocks*

## SPACECRAFT PROPULSION AND POWER

Includes main propulsion systems and components, e.g., rocket engines; and spacecraft auxiliary power sources. For related information see also *07 Aircraft Propulsion and Power*, *28 Propellants and Fuels*, *15 Launch Vehicles and Launch Operations*, and *44 Energy Production and Conversion*.

**20090035822** NASA Ames Research Center, Moffett Field, CA, USA

### Fault Diagnostics and Prognostics for Large Segmented SRMs

Luchinsky, Dmitry; Osipov, Viatcheslav V.; Smelyanskiy, Vadim N.; Timucin, Dogan A.; Uckun, Serdar; Hayashida, Ben; Watson, Michael; McMillin, Joshua; Shook, David; Johnson, Mont; Hyde, Scott; March 07, 2009; 8 pp.; In English; IEEE 2009 Aerospace, 7-14 Mar. 2000, Big Sky, MT, USA; Original contains color and black and white illustrations

Report No.(s): ARC-E-DAA-TN-311; IEEEAC Paper #1001; Copyright; Avail.: Other Sources

We report progress in development of the fault diagnostic and prognostic (FD&P) system for large segmented solid rocket motors (SRMs). The model includes the following main components: (i) 1D dynamical model of internal ballistics of SRMs; (ii) surface regression model for the propellant taking into account erosive burning; (iii) model of the propellant geometry; (iv) model of the nozzle ablation; (v) model of a hole burning through in the SRM steel case. The model is verified by comparison of the spatially resolved time traces of the flow parameters obtained in simulations with the results of the simulations obtained using high-fidelity 2D FLUENT model (developed by the third party). To develop FD&P system of a case breach fault for a large segmented rocket we notice [1] that the stationary zero-dimensional approximation for the nozzle stagnation pressure is surprisingly accurate even when stagnation pressure varies significantly in time during burning tail-off. This was also found to be true for the case breach fault [2]. These results allow us to use the FD&P developed in our earlier research [3]-[6] by substituting head stagnation pressure with nozzle stagnation pressure. The axial corrections to the value of the side thrust due to the mass addition are taken into account by solving a system of ODEs in spatial dimension.

Author

*Fault Detection; Solid Propellant Rocket Engines; Ballistics; Regression Analysis; Erosive Burning; Ablation; Flow Characteristics; Diagnosis; Stagnation Pressure*

**20090035907** Air Force Research Lab., Edwards AFB, CA USA

**Investigation of Low Discharge Voltage Hall Thruster Characteristics and Evaluation of Loss Mechanisms**

Brown, Daniel L.; 2009; 378 pp.; In English; Original contains color and black and white illustrations

Contract(s)/Grant(s): Proj-33SP

Report No.(s): AD-A504587; AFRL-RZ-ED-TP-2009-188; No Copyright; Avail.: Defense Technical Information Center (DTIC)

ONLINE: <http://hdl.handle.net/100.2/ADA504587>

During the early development stages of Hall thruster technology, plasma research and propulsion advancements centered primarily on 300 V, 1600 s specific impulse operation. Since the first thruster firing on a Soviet satellite in 1972, extensive investigations of the plasmadynamic discharge phenomena and operating characteristics progressed the propulsion concept to a high-level of performance suitable for a wide range of near-earth maneuvers and interplanetary missions. The expanded performance envelope is primarily a function of improvements in thruster lifetime, thermal margin, discharge stability, and power system capability. Advancements in the Hall thruster propulsion system have enabled a wider range of input parameters to the thruster, including the applied anode potential. Operation in the low discharge voltage regime is associated with a decline in total thruster efficiency. This dissertation is intended to investigate low voltage Hall thruster physics, identify dominant performance loss mechanisms, and determine the discharge characteristics that drive efficiency.

DTIC

*Hall Thrusters; Losses; Low Voltage*

## 23

### CHEMISTRY AND MATERIALS (GENERAL)

Includes general research topics related to the composition, properties, structure, and use of chemical compounds and materials as they relate to aircraft, launch vehicles, and spacecraft. For specific topics in chemistry and materials see *categories 25 through 29*. For astrochemistry see category *90 Astrophysics*.

**20090035581** Jet Propulsion Lab., California Inst. of Tech., Pasadena, CA, USA

**Retrieval of Mid-tropospheric CO<sub>2</sub> Directly from AIRS Measurements**

Olsen, Edward T.; Chahine, Moustafa T.; Chen, Luke L.; Pagano, Thomas S.; March 18, 2008; 6 pp.; In English; SPIE Conference: Algorithms and Technologies for Multispectral, Hyperspectral and Ultraspectral, 18 Mar. 2008, Orlando, FL, USA; Original contains color illustrations; Copyright; Avail.: Other Sources

ONLINE: <http://hdl.handle.net/2014/41388>

We apply the method of Vanishing Partial Derivatives (VPD) to AIRS spectra to retrieve daily the global distribution of CO<sub>2</sub> at a nadir geospatial resolution of 90 km x 90 km without requiring a first-guess input beyond the global average. Our retrievals utilize the 15 (micro)m band radiances, a complex spectral region. This method may be of value in other applications, in which spectral signatures of multiple species are not well isolated spectrally from one another.

Author

*Carbon Dioxide; Spectral Signatures; Radiance; Spectral Bands*

**20090035832** NASA Ames Research Center, Moffett Field, CA, USA

**Carbon Nanotube Based Chemical Sensors for Space and Terrestrial Applications**

Li, Jing; Lu, Yijiang; May 24, 2009; 7 pp.; In English; Electrochemical Society Spring Meeting 2009, 24-29 May 2009, San Francisco, CA, USA; Original contains color and black and white illustrations

Contract(s)/Grant(s): WBS 999574.01.02.01.01

Report No.(s): ARC-E-DAA-TN452; Copyright; Avail.: CASI: [A02](#), Hardcopy

ONLINE: <http://hdl.handle.net/2060/20090035832>

A nanosensor technology has been developed using nanostructures, such as single walled carbon nanotubes (SWNTs), on a pair of interdigitated electrodes (IDE) processed with a silicon-based microfabrication and micromachining technique. The IDE fingers were fabricated using photolithography and thin film metallization techniques. Both in-situ growth of nanostructure materials and casting of the nanostructure dispersions were used to make chemical sensing devices. These sensors have been exposed to nitrogen dioxide, acetone, benzene, nitrotoluene, chlorine, and ammonia in the concentration range of ppm to ppb at room temperature. The electronic molecular sensing of carbon nanotubes in our sensor platform can be understood by intra- and inter-tube electron modulation in terms of charge transfer mechanisms. As a result of the charge transfer, the conductance of p-type or hole-rich SWNTs in air will change. Due to the large surface area, low surface energy



barrier and high thermal and mechanical stability, nanostructured chemical sensors potentially can offer higher sensitivity, lower power consumption and better robustness than the state-of-the-art systems, which make them more attractive for defense and space applications. Combined with MEMS technology, light weight and compact size sensors can be made in wafer scale with low cost. Additionally, a wireless capability of such a sensor chip can be used for networked mobile and fixed-site detection and warning systems for military bases, facilities and battlefield areas.

Author

*Nanostructures (Devices); Carbon Nanotubes; Charge Transfer; Electrodes; Detection; Warning Systems; Thermal Stability; Micromachining; Microelectromechanical Systems*

## 24

### COMPOSITE MATERIALS

Includes physical, chemical, and mechanical properties of laminates and other composite materials.

**20090034904** National Inst. for Occupational Safety and Health, Cincinnati, OH, USA

**In-Depth Survey Report: Control Technology for Fiber Reinforced Plastics Industry at Philips Industries Incorporated, Lasco Division, Elizabethtown, Pennsylvania**

Todd, W. F.; Dec. 07, 1983; 29 pp.; In English

Report No.(s): PB2009-113672; ECTB-107-17B; No Copyright; Avail.: CASI: [A03](#), Hardcopy

This plant was well designed to control styrene vapor for the original production schedule of one shift operation. This was apparent in the preliminary survey in March 1983 and is supported by personal sampling data obtained by the company in February 1983. The redesign of the ventilation system for the barrier and gel coating areas was brought about by the scheduling of a second production shift. The most important result of this survey was the realization that the installation of the styrene vapor incinerator changed the styrene exposure level drastically in the gel and barrier coating areas and to a lesser extent in the laminating areas. This has changed what appeared to be an ideal cross flow ventilation system into one which marginally meets the PEL of 100 ppm styrene in the gel and barrier coating areas and substantially raises the exposure of the lamination workers. In the case of the lamination workers, it is not clear why the exposure has almost doubled since the ventilation flow rates in the lamination areas did not change significantly due to the installation of the styrene vapor incinerator. It is concluded that because of the increase of styrene exposure in the barrier and gel coating areas, the reduced ventilation in those areas is an unsatisfactory approach to meeting pollution emission standards. It is acknowledged that 20,000 CFM is a large volume of air to treat by incineration, adsorption or absorption but other approaches to removing styrene from the exhaust air should be examined.

NTIS

*Industries; Reinforced Plastics; Reinforcing Fibers; Surveys*

**20090035755** Air Force Research Lab., Wright-Patterson AFB, OH USA; University of North Texas, Denton, TX, USA

**Laser-Deposited Carbon Nanotube Reinforced Nickel Matrix Composites**

Hwang, J. Y.; Neira, A.; Scharf, T. W.; Tiley, J.; Banerjee, R.; February 2008; 20 pp.; In English; Original contains black and white illustrations

Contract(s)/Grant(s): FA9550-06-1-0193; Proj-4347; 62102F

Report No.(s): AD-A504523; AFRL-RX-WP-TP-2009-4214; No Copyright; Avail.: Defense Technical Information Center (DTIC)

ONLINE: <http://hdl.handle.net/100.2/ADA504523>

Composites based on multi-walled carbon nanotubes dispersed in nickel matrix have been processed using the laser-engineered net shape technique. The present study focuses on the survival of nanotubes in liquid nickel matrix during melt processing. The stability of nanotubes versus graphite powders in liquid nickel has been compared by processing both types of composites under identical conditions and subsequently characterizing their microstructure and chemical stability in detail using scanning and transmission electron microscopy, and micro-Raman spectroscopy.

DTIC

*Carbon Nanotubes; Laser Deposition; Lasers; Metal Matrix Composites; Metal Powder; Nanocomposites; Nickel; Nickel Alloys; Reinforcing Materials; YAG Lasers*

## 25

### INORGANIC, ORGANIC AND PHYSICAL CHEMISTRY

Includes the analysis, synthesis, and use of inorganic and organic compounds; combustion theory; electrochemistry; and photochemistry. For related information see category 34 *Fluid Dynamics and Thermodynamics*. For astrochemistry see category 90 *Astrophysics*.

**20090035566** Air Force Research Lab., Brooks AFB, TX USA

#### **Altitude Chamber Testing of the Passenger Oxygen System (POS)**

Miller, George W.; August 2009; 232 pp.; In English

Contract(s)/Grant(s): Proj-7757

Report No.(s): AD-A505310; AFRL-RH-BR-TR-2009-0047; No Copyright; Avail.: Defense Technical Information Center (DTIC)

AFRL/711 HPW/RHPG, Brooks City-Base TX conducted safe-to-fly testing of the CV-22 Passenger Oxygen System (POS). The CV-22 is an unpressurized aircraft. POS is a self-contained, roll-on/roll-off system to support passengers or paratroopers during high altitude operations and patients during medevac. POS includes a device for storing liquid oxygen, regulating the system pressure, and distributing oxygen to cargo area seats. POS is secured on the V-22 like cargo, has removable ballistic protection, and requires no aircraft modifications. One or two POS units can be installed in the CV-22 cargo area. The system successfully passed testing in the passenger, paratrooper, and medevac configurations. Two (2) POS units can support up to 20 passengers to 17,999 feet MSL, up to 16 paratroopers to 24,999 feet MSL, and up to 12 patients to 10,000 feet MSL.

DTIC

*Altitude Simulation; Liquid Oxygen; Oxygen; Oxygen Supply Equipment; Passengers*

## 26

### METALS AND METALLIC MATERIALS

Includes physical, chemical, and mechanical properties of metals and metallic materials; and metallurgy.

**20090035756** Air Force Research Lab., Wright-Patterson AFB, OH USA

#### **Constitutive Modeling of Low-Temperature Superplastic Flow of Ultrafine Ti-6Al-4V Sheet Material**

Semiatin, S. L.; Sargent, G. A.; June 2009; 8 pp.; In English; Original contains black and white illustrations

Contract(s)/Grant(s): FA8650-04-D-5235; Proj-4347; 62102F

Report No.(s): AD-A504524; AFRL-RX-WP-TP-2009-4216; No Copyright; Avail.: Defense Technical Information Center (DTIC)

ONLINE: <http://hdl.handle.net/100.2/ADA504524>

The low-temperature superplastic flow behavior of two lots of Ti-6Al-4V sheet with an ultrafine microstructure was modeled. One lot (Sheet A) had an equiaxed-alpha starting microstructure; the flow stress/flow hardening exhibited by this material was explained on the basis of the Bird-Mukherjee-Dorn constitutive equation. The other material (Sheet B), having a mixed equiaxed- and remnant-lamellar alpha microstructure, underwent flow softening, flow hardening, or steady-state flow depending on test temperature and strain rate. These behaviors were interpreted in the context of a dynamic spheroidization model. The apparent flow softening at the end of all of the flow curves was explained using a simple flow-localization model.

DTIC

*Aluminum Alloys; Low Temperature; Mathematical Models; Metal Sheets; Models; Position (Location); Superplasticity; Titanium Alloys*

## 27

### NONMETALLIC MATERIALS

Includes physical, chemical, and mechanical properties of plastics, elastomers, lubricants, polymers, textiles, adhesives, and ceramic materials. For composite materials see 24 *Composite Materials*.

**20090035563** Forest Products Lab., Madison, WI, USA

#### **Research, Technology Transfer, and Education Needs Assessment for Non-Residential Wood Structures in California**

Williamson, T.; O'Connor, J.; Martinson, K. L.; Jun. 2009; 13 pp.; In English

Report No.(s): PB2009-113654; FPL-FSGTR-183; No Copyright; Avail.: CASI: A03, Hardcopy

Market share growth for wood products in the area of non-residential construction will require research, technology



transfer, and education for architects, engineers, general contractors, and others involved in the decision-making process. To accomplish this in the most efficient and cost-effective manner, an assessment of user-based needs is desirable. This paper summarizes the results of three half-day needs assessment workshops with design professionals and wood product suppliers from southern California. From these workshops, an overall assessment of wood as a building material was formulated and recommendations were made for new products and systems, research activities, and education and technology transfer. This assessment will serve as the basis for development and implementation of a national research program for wood-frame non-residential buildings through the U.S. Forest Service, Forest Products Laboratory, FPInnovations, and the Coalition for Advanced Wood Structures.

NTIS

*Education; Technology Transfer; Wood*

**20090035833** NASA Ames Research Center, Moffett Field, CA, USA

**Assessment of the State of the Art of Ultra High Temperature Ceramics**

Johnson, Sylvia; Gasch, Matt; Stackpoole, Mairead; October 12, 2009; 5 pp.; In English; 16th AIAA/DLR/DGLR International Space Planes and Hypersonic Systems and Technologies Conference, 12-16 Oct, 2009, Bremen, Germany; Original contains black and white illustrations

Contract(s)/Grant(s): NNA04BC25C

Report No.(s): ARC-E-DAA-TN486; Copyright; Avail.: CASI: [A01](#), Hardcopy

ONLINE: <http://hdl.handle.net/2060/20090035833>

Ultra High Temperature Ceramics (UHTCs) are a family of materials that includes the borides, carbides and nitrides of hafnium-, zirconium- and titanium-based systems. UHTCs are famous for possessing some of the highest melting points of known materials. In addition, they are very hard, have good wear resistance, mechanical strength, and relatively high thermal conductivities (compared to other ceramic materials). Because of these attributes, UHTCs are ideal for thermal protection systems, especially those that require chemical and structural stability at extremely high operating temperatures. UHTCs have the potential to revolutionize the aerospace industry by enabling the development of sharp hypersonic vehicles or atmospheric entry probes capable of the most extreme entry conditions.

Author

*Ceramics; High Temperature; Borides; Melting Points; Hafnium; Zirconium; Titanium; Wear Resistance*

**20090035834** NASA Ames Research Center, Moffett Field, CA, USA

**Role of Microstructure on the Performance of UHTC's**

Johnson, Sylvia M.; Gasch, Matthew J.; Stackpoole, Mairead; Gusman, Mike; Thornton, Jeremy; October 25, 2009; 1 pp.; In English; 2009 MS & T, 25-29 Oct. 2009, Pittsburg, PA, USA

Contract(s)/Grant(s): NNA04BC25C

Report No.(s): ARC-E-DAA-TN484; Copyright; Avail.: Other Sources; Abstract Only

UHTCs, because of their refractory nature and high thermal conductivity, are candidates for use on sharp leading edges of hypersonic vehicles. NASA Ames has been investigating the use of UHTCs in the HfB<sub>2</sub>/SiC family under NASA's Fundamental Aeronautics Program. The goal of this work has been to tailor the microstructure to improve mechanical properties and the performance in reentry conditions, as determined by arcjet testing. This talk discusses results of mechanical evaluation and arcjet testing of various materials with different microstructures, including the incorporation of high-temperature fibers in these materials to improve fracture toughness. Some preliminary information on UHTC composites will also be discussed.

Author

*Ceramics; High Temperature; Microstructure; Sharp Leading Edges; Mechanical Properties; Fracture Strength*

**20090035841** NASA Ames Research Center, Moffett Field, CA, USA

**Ultra High Temperature Ceramics' Processing Routes and Microstructures Compared**

Gusman, Michael; Stackpoole, Mairead; Johnson, Sylvia; Gasch, Matt; Lau, Kai-Hung; Sanjurjo, Angel; October 25, 2009; 1 pp.; In English; 2009 MS&, 25-29 Oct. 2009, Pittsburg, PA, USA

Contract(s)/Grant(s): NNA04BC25C

Report No.(s): ARC-E-DAA-TN498; Copyright; Avail.: Other Sources; Abstract Only

Ultra High Temperature Ceramics (UHTCs), such as HfB<sub>2</sub> and ZrB<sub>2</sub> composites containing SiC, are known to have good thermal shock resistance and high thermal conductivity at elevated temperatures. These UHTCs have been proposed for a

number of structural applications in hypersonic vehicles, nozzles, and sharp leading edges. NASA Ames is working on controlling UHTC properties (especially, mechanical properties, thermal conductivity, and oxidation resistance) through processing, composition, and microstructure. In addition to using traditional methods of combining additives to boride powders, we are preparing UHTCs using coating powders to produce both borides and additives. These coatings and additions to the powders are used to manipulate and control grain-boundary composition and second- and third-phase variations within the UHTCs. Controlling the composition of high temperature oxidation by-products is also an important consideration. The powders are consolidated by hot-pressing or field-assisted sintering (FAS). Comparisons of microstructures and hardness data will be presented.

Author

*High Temperature; Ceramics; Hot Pressing; Thermal Conductivity; Structural Design; Shock Resistance; Oxidation Resistance; Grain Boundaries; Mechanical Properties*

**20090035866** NASA Ames Research Center, Moffett Field, CA, USA

#### **Validation of PICA Ablation and Thermal-Response Model at Low Heat Flux**

Milos, Frank S.; Chen, Yih-Kanq; June 22, 2009; 1 pp.; In English; 2009 National Space and Missile Materials Symposium, 22-25 Jun. 2009, Henderson, NV, USA

Report No.(s): ARC-E-DAA-TN293; TSM-0001; No Copyright; Avail.: Other Sources; Abstract Only

Phenolic Impregnated Carbon Ablator (PICA) was the forebody heatshield material on the Stardust sample-return capsule and is also a primary candidate material for the Mars Science Lander (MSL), the Orion Crew Module, and the SpaceX Dragon vehicle. As part of the heatshield qualification for Orion, physical and thermal properties of virgin and charred PICA were measured, and an ablation and thermal response model was developed. We validated the model by comparing it with recession and temperature data from stagnation arcjet tests conducted over a wide range of stagnation heat flux of 107 to 1102 W/sq cm. The effect of orthotropic thermal conductivity was evident in the thermal response of the arcjet models. In general, model predictions compared well with the data; however, the uncertainty of the recession prediction was greatest for heat fluxes below 200 W/sq cm. More recent MSL testing focused on the low heat flux regime of 45 to 250 W/sq cm. The new results confirm the recession uncertainty, especially for pressures below 6 kPa. In this work we focus on improving the model predictions for MSL and Orion tests below 250 W/sq cm.

Author

*Ablative Materials; Heat Flux; Forebodies; Heat Shielding; Temperature Effects; Thermal Conductivity; Thermodynamic Properties; Carbon*

## **28**

### **PROPELLANTS AND FUELS**

Includes rocket propellants, igniters, and oxidizers; their storage and handling procedures; and aircraft fuels. For nuclear fuels see *73 Nuclear Physics*. For related information see also *07 Aircraft Propulsion and Power*; *20 Spacecraft Propulsion and Power*; and *44 Energy Production and Conversion*.

**20090034914** Army Research Development and Engineering Command, Warren, MI USA

#### **Fuel Efficient Ground Vehicle Demonstrator (FED) Vision**

Mathes, Thomas M; Sep 30, 2008; 9 pp.; In English; Original contains color illustrations

Report No.(s): AD-A505229; No Copyright; Avail.: Defense Technical Information Center (DTIC)

DoD Energy Security Goals: Increase force protection (Fewer fuel convoys means fewer people and systems in harm's way); Increase sustainability (Operate for longer/go farther without resupply); Reduce O&S costs (Crude oil closed at \$96.37/Bbl on 11-7-07; DoD standard (refined) price is additional \$25/Bbl); Free up manpower and equipment. Reduce dependency on foreign oil (Reduce revenue flow to unfriendly/unstable nations.) ... The Fuel Efficiency Demonstrator (FED) Program was initiated by OSD to address energy conservation needs highlighted by the Defense Science Board: Energy Security Task Force. The overarching goal of the program is to improve military vehicle technology to reduce fuel consumption on the battlefield, and reduce our dependence on oil.

DTIC

*Fuel Systems; Proving*

**20090034915** Army Research Development and Engineering Command, Warren, MI USA

**Ground Vehicle Power and Mobility (GVPM)**

Blain, Michael; Apr 15, 2008; 14 pp.; In English; Original contains color illustrations

Report No.(s): AD-A505230; No Copyright; Avail.: Defense Technical Information Center (DTIC)

PROBLEM: Current high power commercial engines are not compact enough for future manned ground combat platforms. Future ground combat vehicles will require lighter and more efficient engines that occupy less space. Current state of the art engines require significant development to operate on one fuel and meet future vehicle power and mobility needs. RESEARCH CHALLENGES: Diesel combustion research to increase physical burn time; Propulsion system research to increase power density; Engine thermal management research; Research combustion optimization strategy for JP-8 military version of an emission compliant commercial engine.

DTIC

*Diesel Engines; Fuels; JP-8 Jet Fuel; Mobility*

**20090035560** Army Research Development and Engineering Command, Warren, MI USA

**Alternative Fuels**

Muzzell, Pat; June 11, 2009; 22 pp.; In English; Original contains color illustrations

Report No.(s): AD-A505274; RDECOM/TARDEC-19948RC; No Copyright; Avail.: Defense Technical Information Center (DTIC)

INTRODUCTION: Transportation Market Evolution; Tactical Mobility Fuel. SINGLE FUEL IN the BATTLEFIELD: What is the Single Fuel? Certification/Qualification Pipeline; DARPA Alternative Jet Fuels Program. COORDINATING the OVERALL ALTERNATIVE FUEL QUALIFICATION PROCESS: Tri-Service POL Users Group; Within Army. ALTERNATIVE FUELS QUALIFICATION - STATUS; ARMY FUEL REQUIREMENTS and THE JP-8 SPEC.

DTIC

*Energy Policy; Jet Engine Fuels; Synthetic Fuels*

**20090036335** NASA Kennedy Space Center, Cocoa Beach, FL, USA

**Applying Model-based Diagnosis to a Rapid Propellant Loading System**

Goodrich, Charlie H.; Narasimhan, Sriram; Daigle, Matthew J.; Hatfield, Walter H.; Johnson, Robert G.; June 14, 2009; 9 pp.; In English; 20th International Workshop on Principles of Diagnosis (DX-09), 14-17 Jun. 2009, Stockholm, Sweden; Original contains color and black and white illustrations

Report No.(s): ARC-E-DAA-TN531; Copyright; Avail.: CASI: A02, Hardcopy

ONLINE: <http://hdl.handle.net/2060/20090036335>

The overall objective of the US Air Force Research Laboratory (AFRL) Rapid Propellant Loading (RPL) Program is to develop a launch vehicle, payload and ground support equipment that can support a rapid propellant load and launch within one hour. NASA Kennedy Space Center (KSC) has been funded by AFRL to develop hardware and software to demonstrate this capability. The key features of the software would be the ability to recognize and adapt to failures in the physical hardware components, advise operators of equipment faults and workarounds, and put the system in a safe configuration if unable to fly. In December 2008 NASA KSC and NASA Ames Research Center (ARC) demonstrated model based simulation and diagnosis capabilities for a scaled-down configuration of the RPL hardware. In this paper we present a description of the model-based technologies that were included as part of this demonstration and the results that were achieved. In continuation of this work we are currently testing the technologies on a simulation of the complete RPL system. Later in the year, when the RPL hardware is ready, we will be integrating these technologies with the real-time operation of the system to provide live state estimates. In future years we will be developing the capability to recover from faulty conditions via redundancy and reconfiguration.

Author

*Loads (Forces); Military Technology; Mathematical Models; Computerized Simulation; Propellants*

31  
**ENGINEERING (GENERAL)**

Includes general research topics related to engineering and applied physics, and particular areas of vacuum technology, industrial engineering, cryogenics, and fire prevention. For specific topics in engineering see *categories 32 through 39*.

**20090034889** Army Tank-Automotive Research and Development Command, Warren, MI USA

**Technology Transition Brief**

Kozierowski, Jeff; May 14, 2009; 8 pp.; In English; Original contains color illustrations

Report No.(s): AD-A505185; TARDEC-19851RC; No Copyright; Avail.: Defense Technical Information Center (DTIC)

Briefing looks at the following TARDEC areas of research: Prognostics & Diagnostics Value Chains, Advanced Diagnostics for Diesel Engines, Transmission Health Assessments, Alternator Health Assessments, Battery Aging Study, and Tactical Wheeled Vehicle System Integration Lab (SIL).

DTIC

*Surface Vehicles; Diesel Engines; Technology Assessment*

**20090034897** Department of the Navy, Washington, DC USA

**System and Method for Controlling the Power Output of an Internal Combustion Engine**

Mileski, Paul M, Inventor; Mar 13, 2009; 22 pp.; In English

Report No.(s): AD-D020409; No Copyright; Avail.: Other Sources

ONLINE: <http://hdl.handle.net/100.2/ADD020409>

A system and method are provided to control the power output, fuel efficiency and gas emissions of an internal combustion engine using an exhaust gas recirculation system. A recirculation loop containing a heat exchanger and an accumulator is installed between the exhaust ports and intake ports of the cylinders of the internal combustion engine. Diverter valves are used to control the amount of exhaust gas directed into the recirculation loop and the proportion of exhaust gas entering the intake ports. Controlling the amount of re-circulated exhaust gas and proportion of exhaust gas in the intake ports thereby controls the power output of the internal combustion engine.

DTIC

*Internal Combustion Engines; Power Efficiency*

**20090035561** Army Tank-Automotive Research and Development Command, Warren, MI USA

**TARDEC Dual Use Technology Briefing (Slides)**

DiSante, Peter; Mainero, Jim; Novak, Martin; August 2009; 15 pp.; In English; Original contains color illustrations

Report No.(s): AD-A505285; TARDEC-20027RC; No Copyright; Avail.: Defense Technical Information Center (DTIC)

This briefing looks at the various partnerships, agreements and arrangements that the government has with industry and academia to foster technology development and transfer.

DTIC

*Chutes; Technology Transfer*

**20090035752** Department of Defense, Fort Meade, MD USA

**Results of a Block II GPS Users Survey**

Bartholomew, Thomas R.; Bloor, Stephen M.; Proceedings of the Twenty-first Annual Precise Time and Time Interval (PTTI) Applications and Planning Meeting; November 1989, pp. 74-76; In English; 21st Annual Precise Time and Time Interval (PTTI) Applications and Planning Meeting, 28-30 Nov. 1989, Redondo Beach, CA, USA

Report No.(s): AD-A504948; No Copyright; Avail.: Defense Technical Information Center (DTIC)

ONLINE: <http://hdl.handle.net/100.2/ADA504948>

As part of a system development the authors were required to select appropriate standards and cost-effective techniques for time recovery and frequency control. It quickly became apparent that GPS offered a good across-the-board solution to the system requirements for: (1) time recovery; (2) synchrony; (3) frequency control; (4) syntony and (5) precise positioning. It was also apparent, with the advent of Block II, selective availability (SA) and anti-spoofing (AS), that the performance of presently available time recovery receivers would potentially be inadequate to meet our system requirements. It was further evident that readily available, cost-effective receivers were not in the near-term plans of any of the contacted manufacturers. We therefore undertook to encourage the development and competitive availability of authorized user receivers capable of achieving the full time and frequency performance capabilities of GPS within the Block II environment. As part of that effort

we reviewed our requirements with a representative set of receiver manufacturers. In addition, we distributed a questionnaire to over 1300 projected authorized users. This was an attempt to determine: (1) the range of user requirements; (2) the size of the potential market; and (3) the degree of user interest in establishing an authorized user group (AUUG). This paper presents the results of the survey, reports on our progress in organizing the user/working group and briefly describes some of the concepts proposed to provide cost-effective solutions to the problem.

DTIC

*Global Positioning System; Surveys*

**20090035753** National Inst. of Standards and Technology, Boulder, CO USA

**Precise Ephemerides for GPS Time Transfer**

Lewandowski, W.; Weiss, M. A.; Proceedings of the 21st Annual Precise Time and Time Interval (PTTI) Applications and Planning Meeting; November 1989, pp. 95-106; In English; 21st Annual Precise Time and Time Interval (PTTI) Applications and Planning Meeting, 28-30 Nov. 1989, Redondo Beach, CA, USA; Original contains black and white illustrations

Report No.(s): AD-A504950; No Copyright; Avail.: Defense Technical Information Center (DTIC)

ONLINE: <http://hdl.handle.net/100.2/ADA504950>

The present technology of atomic clocks motivates time transfer techniques with nanosecond accuracy. Global Positioning System (GPS), the most common means for international time comparisons could achieve such accuracy over short distances (up to 1000 km). Over intercontinental distances the accuracy of the GPS time transfer ranges between 20 and 30 ns. Some of the principal error sources are the broadcast ephemerides, the broadcast ionospheric model, and the local antenna coordinates. This study investigates the quality of broadcast ephemerides by comparing them with precise ephemerides and by using precise ephemerides for time transfer. Another aspect of this work is to suggest a strategy to overcome the planned degradation of GPS satellite messages via Selective Availability (SA).

DTIC

*Ephemerides; Global Positioning System*

**20090035820** NASA Ames Research Center, Moffett Field, CA, USA

**A Corrosion Risk Assessment Model for Underground Piping**

Datta, Koushik; Fraser, Douglas R.; January 26, 2009; 5 pp.; In English; 2009 Annual Reliability and Maintainability Symposium (RAMS), 26-29 Jan. 2009, Fort Worth, TX, USA; Original contains color illustrations

Contract(s)/Grant(s): WBS 939904

Report No.(s): ARC-E-DAA-TN203; No Copyright; Avail.: CASI: [A01](#), Hardcopy

ONLINE: <http://hdl.handle.net/2060/20090035820>

The Pressure Systems Manager at NASA Ames Research Center (ARC) has embarked on a project to collect data and develop risk assessment models to support risk-informed decision making regarding future inspections of underground pipes at ARC. This paper shows progress in one area of this project - a corrosion risk assessment model for the underground high-pressure air distribution piping system at ARC. It consists of a Corrosion Model of pipe-segments, a Pipe Wrap Protection Model; and a Pipe Stress Model for a pipe segment. A Monte Carlo simulation of the combined models provides a distribution of the failure probabilities. Sensitivity study results show that the model uncertainty, or lack of knowledge, is the dominant contributor to the calculated unreliability of the underground piping system. As a result, the Pressure Systems Manager may consider investing resources specifically focused on reducing these uncertainties. Future work includes completing the data collection effort for the existing ground based pressure systems and applying the risk models to risk-based inspection strategies of the underground pipes at ARC.

Author

*Corrosion; Risk Assessment; Pipes (Tubes); Systems Management; High Pressure; Risk*



## 32 COMMUNICATIONS AND RADAR

Includes radar; radio, wire, and optical communications; land and global communications; communications theory. For related information see also 04 Aircraft Communications and Navigation; and 17 *Space Communications, Spacecraft Communications, Command and Tracking*; for search and rescue, see 03 *Air Transportation and Safety*; and 16 *Space Transportation and Safety*.

**20090034923** California Inst. of Tech., Pasadena, CA USA

### **The Representation of Communication and Concurrency**

Milne, George J; Sep 1980; 108 pp.; In English

Contract(s)/Grant(s): AFOSR-80-0274; MCS-8011925

Report No.(s): AD-A504936; No Copyright; Avail.: Defense Technical Information Center (DTIC)

ONLINE: <http://hdl.handle.net/100.2/ADA504936>

A formal system is described within which we may represent the communication and concurrency features found in systems of interacting computing agents. This formal system may be used both as a model in which to represent the behaviour of existing systems of computing agents or as a language in which to program desired systems. The notion of acceptance semantics is introduced and it is in terms of this that we give meaning to programs constructed in our framework.

DTIC

*Telecommunication; Semantics*

**20090034926** Army Command and General Staff Coll., Fort Leavenworth, KS USA

### **Effective Multinational C2: Five Essential Variables**

Baker, Jon E; May 2009; 54 pp.; In English; Original contains color illustrations

Report No.(s): AD-A504998; No Copyright; Avail.: Defense Technical Information Center (DTIC)

ONLINE: <http://hdl.handle.net/100.2/ADA504998>

USA armed forces have historically fought alongside allied forces, and are currently engaged in several multinational operations around the world. Most, if not all, future U.S. military peacekeeping, combat, or stability operations will continue to consist of multinational structures commonly known as coalitions or alliances. The inherent complexity of creating an effective multinational Command and Control (C2) structure, comprised of different countries and operating under unfamiliar C2 structures, creates tension in achieving unity of effort, unity of command and unity of action towards subsequent mission accomplishment. Historically this tension has revolved around the issue of multinational C2. Differences in national interests, culture, and incompatibilities in operating procedures, technologies, training and operational capabilities add to the tension posed by multinational operations. Fortunately, U.S. Joint, U.S. service, and NATO doctrine, as well as history, provide useful guidelines to ameliorate the tension posed by multinational differences and incompatibilities towards effective multinational C2.

DTIC

*Command and Control; Control Systems Design; Stability*

**20090034981** Maryland Univ. Baltimore County, Catonsville, MD, USA

### **Retrieval of Snow and Rain From Combined X- and W-B and Airborne Radar Measurements**

Liao, Liang; Meneghini, Robert; Tian, Lin; Heymsfield, Gerald M.; IEEE Transactions on Geoscience and Remote Sensing; May 2008; Vol. 46, No. 5, pp. 1514-1524; In English; Original contains black and white illustrations; Copyright; Avail.:

Other Sources

ONLINE: <http://dx.doi.org/10.1109/TGRS.2008.916079>

Two independent airborne dual-wavelength techniques, based on nadir measurements of radar reflectivity factors and Doppler velocities, respectively, are investigated with respect to their capability of estimating microphysical properties of hydrometeors. The data used to investigate the methods are taken from the ER-2 Doppler radar (X-band) and Cloud Radar System (W-band) airborne Doppler radars during the Cirrus Regional Study of Tropical Anvils and Cirrus Layers-Florida Area Cirrus Experiment campaign in 2002. Validity is assessed by the degree to which the methods produce consistent retrievals of the microphysics. For deriving snow parameters, the reflectivity-based technique has a clear advantage over the Doppler-velocity-based approach because of the large dynamic range in the dual-frequency ratio (DFR) with respect to the median diameter  $D_0$  and the fact that the difference in mean Doppler velocity at the two frequencies, i.e., the differential Doppler velocity (DDV), in snow is small relative to the measurement errors and is often not uniquely related to  $D_0$ . The DFR and DDV can also be used to independently derive  $D_0$  in rain. At W-band, the DFR-based algorithms are highly sensitive to attenuation from rain, cloud water, and water vapor. Thus, the retrieval algorithms depend on various assumptions regarding

these components, whereas the DDV-based approach is unaffected by attenuation. In view of the difficulties and ambiguities associated with the attenuation correction at W-band, the DDV approach in rain is more straightforward and potentially more accurate than the DFR method.

Author

*Airborne Radar; Algorithms; Radar Measurement; Rain; Snow; Clouds (Meteorology)*

**20090035548** National Inst. of Standards and Technology, Gaithersburg, MD, USA

**Manufacturing Interoperability Program, a Synopsis**

Kemmerer, S. J.; Feb. 2009; 64 pp.; In English

Report No.(s): PB2009-113642; NISTIR-7533; No Copyright; Avail.: National Technical Information Service (NTIS)

With a value-added contribution of \$1.5 trillion, U.S. manufacturing directly accounts for 14 percent of the U.S. gross domestic product. Manufacturing plays a central role in our Nations economy. Dollar for dollar, manufacturing has the highest economic impact of all of the economic sectors. Dollar for dollar, manufacturing has the highest-leverage economic impact of all of the economic sectors. As such, manufacturing's ability to innovate and compete is vital to all the other sectors of the economy. Other facts attributable to manufacturing: makes the highest contribution to economic growth of any sector; is responsible for more than 70 percent of private sector research and development and the center for a wide range of advanced technologies that cut energy use and lead to a cleaner environment; achieves a high productivity rate year in and year out, increasing by more than 50 percent in the past decade; contributes more than 60 percent of U.S. exports or about \$50 billion a month; pays wages and benefits that are about 25 percent higher than in non-manufacturing jobs; and multiplies every dollar spent into an additional \$1.37 in economic activity, greater than other sectors.

NTIS

*Information Systems; Interoperability; Manufacturing*

### 33

## ELECTRONICS AND ELECTRICAL ENGINEERING

Includes development, performance, and maintainability of electrical/electronic devices and components; related test equipment; and microelectronics and integrated circuitry. for related information see also *60 Computer Operations and Hardware*; and *76 Solid-State Physics*. For communications equipment and devices see *32 Communications and Radar*.

**20090034912** Air Force Inst. of Tech., Wright-Patterson AFB, OH USA

**Non-GNSS Radio Frequency Navigation**

Raquet, John; Martin, Richard K; Apr 2008; 5 pp.; In English

Report No.(s): AD-A504796; No Copyright; Avail.: Defense Technical Information Center (DTIC)

ONLINE: <http://hdl.handle.net/100.2/ADA504796>

There are many situations in which Global Navigation Satellite Systems (GNSS) such as the Global Positioning System (GPS) cannot provide adequate navigation performance (such as indoors or in urban canyons). This paper describes the technical challenges of non-GNSS radio frequency navigation, with particular emphasis on signals of opportunity (i.e., signals that are intended for purposes other than navigation). Advantages and disadvantages of signal of opportunity navigation are described, along with the dominant issues that must be dealt with in order to make such systems a practical reality.

DTIC

*Navigation; Radio Frequencies; Radio Navigation; Telecommunication*

**20090034913** Army Research Development and Engineering Command, Warren, MI USA

**MEMS, Nanotechnology and Spintronics for Sensor Enhanced Armor, NDE and Army Applications**

Meitzler, Thomas; Jun 16, 2009; 47 pp.; In English; Original contains color illustrations

Report No.(s): AD-A505228; RDECOM/TARDEC-19933RC; No Copyright; Avail.: Defense Technical Information Center (DTIC)

MILITARY APPLICATIONS of MEMS: Signal processing \* Wireless Communication \* Mass data storage \* Sensors for maintenance and structural monitoring \* Unattended sensors for tracking and surveillance \* Biomedical sensors \* Inertial measurements \* Aerodynamic and hydrodynamic systems \* Optical Fiber components and networks.

DTIC

*Armor; Inspection; Microelectromechanical Systems; Nanotechnology; Nondestructive Tests; Semiconductors (Materials)*



**20090035555** Jet Propulsion Lab., California Inst. of Tech., Pasadena, CA, USA

**Thermal Cycle Reliability and Failure Mechanisms of CCGA and PBGA Assemblies with and without Corner Staking**

Ghaffarian, Reza; Transactions On Components And Packaging Technologies; June 2008; ISSN 1521-3331; Volume 31, No. 2, pp. 285-296; In English; Original contains color and black and white illustrations; Copyright; Avail.: Other Sources  
ONLINE: <http://hdl.handle.net/2014/41399>; <http://dx.doi.org/10.1109/TCAPT.2008.921626>

Area array packages (AAPs) with 1.27 mm pitch have been the packages of choice for commercial applications; they are now starting to be implemented for use in military and aerospace applications. Thermal cycling characteristics of plastic ball grid array (PBGA) and chip scale package assemblies, because of their wide usage for commercial applications, have been extensively reported on in literature. Thermal cycling represents the on-off environmental condition for most electronic products and therefore is a key factor that defines reliability. However, very limited data is available for thermal cycling behavior of ceramic packages commonly used for the aerospace applications. For high reliability applications, numerous AAPs are available with an identical design pattern both in ceramic and plastic packages. This paper compares assembly reliability of ceramic and plastic packages with the identical inputs/outputs (I/Os) and pattern. The ceramic package was in the form of ceramic column grid array (CCGA) with 560 I/Os peripheral array with the identical pad design as its plastic counterpart.

Author

*Thermal Cycling Tests; Military Technology; Chips; Aerospace Engineering*

**20090035558** Jet Propulsion Lab., California Inst. of Tech., Pasadena, CA, USA

**Reliability of PWB Microvias for High Density Package Assembly**

Ghaffarian, Reza; International Journal of Materials and Structural Integrity; 2008; Volume 2, Nos. 1/2, pp. 47-63; In English; Original contains color illustrations; Copyright; Avail.: Other Sources  
ONLINE: <http://hdl.handle.net/2014/41400>

High density PWB (printed wiring board) with microvia technology is required for implementation of high density and high I/O area array packages (AAP). COTS (commercial off-the-shelf) AAP packaging technologies in high reliability versions with 1.27 mm pitch are now being considered for use in a number of NASA systems including Space Shuttle and Mars Rovers. NASA functional system designs are requiring more and more dense AAP packages and board space, which makes board microvia technology very attractive for effectively routing a large number of package inputs/outputs. However, the reliability of the fine feature microvias including via in pads is unknown for space applications. Understanding process and QA (quality assurance) indicators for reliability are important for low risk insertion of these newly available packages and PWBs. This paper presents literature search as well as test results for a high density board subjected to various thermal cycle and reflow profiles representative of tin-lead and lead-free solder reflow. Microvias sizes ranged from two to six mil with and without filling. Daisy chain microvias monitored during the test and PWBs were cross-sectioned to determine failure and locations. Optical and SEM photographs as well as resistance changes during cycling and Tg/Td (glass transition/decomposition temperature) characterisations are presented.

Author

*Printed Circuits; Commercial Off-the-Shelf Products; Packaging; Glass Transition Temperature*

**20090035569** Jet Propulsion Lab., California Inst. of Tech., Pasadena, CA, USA

**Current Leakage Evolution in Partially Gate Raptured Power MOSFETs**

Scheick, Leif; Edmonds, Larry; Selva, Luis; Chen, Yuan; IEEE Transactions On Nuclear Science; August 2008; Volume 55, No. 4, pp. 2366-2375; In English; Original contains black and white illustrations; Copyright; Avail.: Other Sources  
ONLINE: <http://hdl.handle.net/2014/41401>; <http://dx.doi.org/10.1109/TNS.2008.2001008>

It has been observed that power MOSFETs can experience an SEGR and continue to function with altered parameters. We propose that there are three different types of SEGR modes; the micro-break, the thermal runaway, and the avalanche breakdown. Data that demonstrates these stages of device failure are presented as well as a proposed model for the micro-break. Brief discussions of the other modes, based on analysis combined with our interpretations of the older literature, are also given.

Author

*Field Effect Transistors; Leakage; Metal Oxide Semiconductors; Failure*

**20090035819** Jet Propulsion Lab., California Inst. of Tech., Pasadena, CA, USA

**Reliability of Low-Pitch, High-I/O Area Array Packages**

Ghaffarian, Reza; April 2009; 48 pp.; In English; Original contains color and black and white illustrations

Contract(s)/Grant(s): NAS7-03001; WBS 939904.01.11

Report No.(s): JPL-Publ-09-15; Copyright; Avail.: CASI: [A03](#), Hardcopy

ONLINE: <http://hdl.handle.net/2060/20090035819>

This report first provides a body of knowledge (BoK) survey for designing, manufacturing, and testing high input/ output (I/O) and low-pitch area array packages. It then presents test data on design, assembly, and environmental evaluation results for various newly available electronics packages assembled onto printed wiring boards (PWBs). Packages included plastic ball grid arrays (PBGAs) with I/Os up to 1156 and 1-mm pitch, high-I/O chip scale packages (CSPs), low-pitch flip chip, microlead frame/quad flat no lead (MLF/QFN), and small resistors to 0201 size. Finally, it summarizes lessons learned from test results for assembly and environmental testing along with optical, scanning electron microscopy (SEM), and x-ray photomicrographs showing damage progress.

Author

*Reliability; Electronic Packaging; NASA Programs; Reliability Analysis; Chips (Electronics); Arrays; Test Vehicles; Pitch (Inclination)*

**20090035829** Stinger Ghaffarin Technologies, Inc., Moffett Field, CA, USA

**A Simple and Efficient Computational Approach to Chafed Cable Time-Domain Reflectometry Signature Prediction**

Kowalski, Marc Edward; March 08, 2009; 4 pp.; In English; Annual Review of Progress in Applied Computational Electromagnetics, 8-12 Mar. 2009, Monterey, CA, USA; Original contains color and black and white illustrations

Contract(s)/Grant(s): NNA08CG83C

Report No.(s): ARC-E-DAA-TN261; No Copyright; Avail.: CASI: [A01](#), Hardcopy

ONLINE: <http://hdl.handle.net/2060/20090035829>

A method for the prediction of time-domain signatures of chafed coaxial cables is presented. The method is quasi-static in nature, and is thus efficient enough to be included in inference and inversion routines. Unlike previous models proposed, no restriction on the geometry or size of the chafe is required in the present approach. The model is validated and its speed is illustrated via comparison to simulations from a commercial, three-dimensional electromagnetic simulator.

Author

*Coaxial Cables; Optical Measurement; Prediction Analysis Techniques; Time Domain Analysis; Signatures*

**20090035830** NASA Ames Research Center, Moffett Field, CA, USA

**A Distributed Prognostic Health Management Architecture**

Bhaskar, Saha; Saha, Sankalita; Goebel, Kai; April 28, 2009; 14 pp.; In English; MFPT 2009, 28-30 Apr. 2009, Dayton, OH, USA; Original contains color illustrations

Report No.(s): ARC-E-DAA-TN401; No Copyright; Avail.: CASI: [A03](#), Hardcopy

ONLINE: <http://hdl.handle.net/2060/20090035830>

This paper introduces a generic distributed prognostic health management (PHM) architecture with specific application to the electrical power systems domain. Current state-of-the-art PHM systems are mostly centralized in nature, where all the processing is reliant on a single processor. This can lead to loss of functionality in case of a crash of the central processor or monitor. Furthermore, with increases in the volume of sensor data as well as the complexity of algorithms, traditional centralized systems become unsuitable for successful deployment, and efficient distributed architectures are required. A distributed architecture though, is not effective unless there is an algorithmic framework to take advantage of its unique abilities. The health management paradigm envisaged here incorporates a heterogeneous set of system components monitored by a varied suite of sensors and a particle filtering (PF) framework that has the power and the flexibility to adapt to the different diagnostic and prognostic needs. Both the diagnostic and prognostic tasks are formulated as a particle filtering problem in order to explicitly represent and manage uncertainties; however, typically the complexity of the prognostic routine is higher than the computational power of one computational element (CE). Individual CEs run diagnostic routines until the system variable being monitored crosses beyond a nominal threshold, upon which it coordinates with other networked CEs to run the prognostic routine in a distributed fashion. Implementation results from a network of distributed embedded devices monitoring a prototypical aircraft electrical power system are presented, where the CEs are Sun Microsystems Small Programmable Object Technology (SPOT) devices.

Author

*Distributed Parameter Systems; Coordinates; Central Processing Units; Algorithms; Deployment*

**20090035880** NASA Kennedy Space Center, Cocoa Beach, FL, USA

**Transparent Conveyor of Dielectric Liquids or Particles**

Calle, Carlos I.; Mantovani, James G.; NASA Tech Briefs, October 2009; October 2009, pp. 23; In English; See also [20090035873](#); Original contains color illustrations

Report No.(s): KSC-12616; Copyright; Avail.: CASI: [A01](#), Hardcopy

ONLINE: <http://hdl.handle.net/2060/20090035880>; <http://www.techbriefs.com/component/content/article/5785>

The concept of a transparent conveyor of small loose dielectric particles or small amounts of dielectric liquids has emerged as an outgrowth of an effort to develop efficient, reliable means of automated removal of dust from solar cells and from windows of optical instruments. This concept is based on the previously reported concept of an electrodynamic screen, according to which a grid-like electric field is established on and near a surface and is moved along the surface perpendicularly to the grid lines. The resulting electrodynamic forces on loose dielectric particles or dielectric liquid drops in the vicinity would move the particles or drops along the surface. In the original dust-removal application, dust particles would thus be swept out of the affected window area. Other potential applications may occur in nanotechnology -- for example, involving mixing of two or more fluids and/or nanoscale particles under optical illumination and/or optical observation.

Derived from text

*Dielectrics; Transparency; Cleaning*

**20090036310** Jet Propulsion Lab., California Inst. of Tech., Pasadena, CA, USA

**Reliability of Recolumned Area Array Packages**

Ghaffarian, Reza; [2009]; 80 pp.; In English; Original contains color and black and white illustrations

Contract(s)/Grant(s): NAS7-03001; 103982.03.03.07; Proj. 103982

Report No.(s): JPL-Publ-09-11; Copyright; Avail.: CASI: [A05](#), Hardcopy

ONLINE: <http://hdl.handle.net/2060/20090036310>

This report presents qualification guidelines developed for recolumned, high I/O ceramic column grid array (CCGA) packages assembled onto printed wiring/circuit boards (PWBs/PCBs). It includes recolumn and assembly process development for two types of CCGA packages: those with and those without interposer. Thermal cycle test results and photomicrographs showing damage progress for recolumned CCGA assemblies are documented and presented.

Author

*Circuit Boards; Printed Circuits; Reliability; Electronic Packaging*

**34**

**FLUID MECHANICS AND THERMODYNAMICS**

Includes fluid dynamics and kinematics and all forms of heat transfer; boundary layer flow; hydrodynamics; hydraulics; fluidics; mass transfer and ablation cooling. For related information see also *02 Aerodynamics*.

**20090034974** Northrop Grumman Corp., El Segundo, CA USA

**Surface Excrescence Transition Study Delivery Order 0053**

Drake, Aaron; Bender, Anne; Apr 2009; 579 pp.; In English; Original contains color illustrations

Contract(s)/Grant(s): F33615-00-D-3054-0053; Proj-A071

Report No.(s): AD-A504656; AFRL-RB-WP-TR-2009-3109; No Copyright; Avail.: Defense Technical Information Center (DTIC)

ONLINE: <http://hdl.handle.net/100.2/ADA504656>

An examination of the effects of surface excrescences on boundary layer transition has been performed, using a unique experimental facility. The experimental study focused on stagnation-line starting condition boundary layers in incompressible flow without sweep effects. The study was performed at flight-representative Reynolds numbers? equivalent to chord Reynolds numbers of 4 to 8 million?and included the effects of favorable pressure gradients. The results for both forward and aft-facing steps indicate a substantial stabilizing effect of favorable pressure gradient on excrescence-induced boundary layer transition. These findings suggest that manufacturing tolerances for laminar flow aircraft could be loosened in areas where even mild favorable pressure gradients exist.

DTIC

*Boundary Layer Transition; Atmospheric Boundary Layer; Pressure Effects; Stabilization*

**20090036333** NASA Langley Research Center, Hampton, VA, USA

**System and Method for Wirelessly Determining Fluid Volume**

Woodard, Stanley E., Inventor; Taylor, Bryant D., Inventor; March 24, 2009; 7 pp.; In English; Original contains black and white illustrations

Patent Info.: Filed Jan. 9, 2006; US-Patent-7506541; NASA-Case-LAR-17116-1; US-Patent-Appl-SN-11/328468; No Copyright; Avail.: CASI: [A02](#), Hardcopy

ONLINE: <http://hdl.handle.net/2060/20090036333>

A system and method are provided for determining the volume of a fluid in container. Sensors are positioned at distinct locations in a container of a fluid. Each sensor is sensitive to an interface defined by the top surface of the fluid. Interfaces associated with at least three of the sensors are determined and used to find the volume of the fluid in the container in a geometric process.

Official Gazette of the U.S. Patent and Trademark Office

*Position (Location); Computational Fluid Dynamics; Measurement; Fluids; Volume*

**35**

**INSTRUMENTATION AND PHOTOGRAPHY**

Includes remote sensors; measuring instruments and gages; detectors; cameras and photographic supplies; and holography. For aerial photography see *43 Earth Resources and Remote Sensing*. For related information see also *06 Avionics and Aircraft Instrumentation*; and *19 Spacecraft Instrumentation and Astrionics*.

**20090034918** Norwegian Seismic Array, Kjeller, Norway

**Expanding Coherent Array Processing to Larger Apertures using Empirical Matched Field Processing**

Ringdal, Frode; Harris, David B; Kvaerna, Tormod; Gibbons, Steven J; Sep 30, 2009; 11 pp.; In English; Original contains color illustrations

Contract(s)/Grant(s): FA8718-08-C-0007; Proj-1010

Report No.(s): AD-A505264; No Copyright; Avail.: Defense Technical Information Center (DTIC)

We have adapted matched field processing--a method developed in underwater acoustics to detect and locate targets--to classify transient seismic signals arising from mining explosions. Matched field processing, as we apply it, is an empirical technique, using observations of historic events to calibrate the amplitude and phase structure of wavefields incident upon an array aperture for particular repeating sources. The objective of this project is to determine how broadly applicable the method is and to understand the phenomena that control its performance. We obtained our original results in distinguishing events from ten mines in the Khibiny and Olenegorsk mining districts of the Kola Peninsula, for which we had exceptional ground truth information. In a cross-validation test, some 98.2% of 549 explosions were correctly classified by originating mine using just the Pn observations (2.5-12.5 Hz) on the ARCES array at ranges from 350 - 410 kilometers. These results were achieved despite the fact that the mines are as closely spaced as 3 kilometers. Such classification performance is significantly better than predicted by the Rayleigh limit. Scattering phenomena account for the increased resolution, as we make clear in an analysis of the information carrying capacity of Pn under two alternative propagation scenarios: free-space propagation and propagation with realistic (actually measured) spatial covariance structure. The increase in information capacity over a wide band is captured by the matched field calibrations and used to separate explosions from very closely-spaced sources. In part, the improvement occurs because the calibrations enable coherent processing at frequencies above those normally considered coherent. We are investigating whether similar results can be expected in different regions, with apertures of increasing scale and for diffuse seismicity.

DTIC

*Apertures; Ground Truth; Underwater Explosions*

**20090035903** California Inst. of Tech., Pasadena, CA, USA

**High-Sensitivity GaN Microchemical Sensors**

Son, Kyung-ah; Yang, Baohua; Liao, Anna; Moon, Jeongsun; Prokopuk, Nicholas; NASA Tech Briefs, October 2009; October 2009, pp. 25-26; In English; See also [20090035873](#); Original contains color illustrations

Report No.(s): NPO-45973; Copyright; Avail.: CASI: [A01](#), Hardcopy

ONLINE: <http://hdl.handle.net/2060/20090035903>; <http://www.techbriefs.com/component/content/article/5788>

Systematic studies have been performed on the sensitivity of GaN HEMT (high electron mobility transistor) sensors using various gate electrode designs and operational parameters. The results here show that a higher sensitivity can be achieved with

a larger W/L ratio (W = gate width, L = gate length) at a given D (D = source-drain distance), and multi-finger gate electrodes offer a higher sensitivity than a one-finger gate electrode. In terms of operating conditions, sensor sensitivity is strongly dependent on transconductance of the sensor. The highest sensitivity can be achieved at the gate voltage where the slope of the transconductance curve is the largest. This work provides critical information about how the gate electrode of a GaN HEMT, which has been identified as the most sensitive among GaN microsensors, needs to be designed, and what operation parameters should be used for high sensitivity detection.

Derived from text

*High Electron Mobility Transistors; Microinstrumentation; Gas Detectors*

**20090035909** Army Developmental Test Command, Aberdeen Proving Ground, MD, USA

**UXO Technology Demonstration Site. Active Site Scoring Record No. 934**

Burch, William; Edwards, Cheryl; Lombardo, Leonard; McClung, J. Stephen; Fling, Rick; McClung, Christina; July 2009; 52 pp.; In English; Original contains color illustrations

Contract(s)/Grant(s): Proj-DTC-8-CO-160-UXO-020

Report No.(s): AD-A504675; ATC-10004; No Copyright; Avail.: Defense Technical Information Center (DTIC)

ONLINE: <http://hdl.handle.net/100.2/ADA504675>

This scoring record documents the efforts of NAEVA Geophysics, Inc. to detect and discriminate inert unexploded ordnance (UXO) utilizing the APG Standardized UXO Technology Demonstration Site Blind Grid, Open Field, and Active Sites. This Scoring Record was coordinated by J. Stephen McClung and the Standardized UXO Technology Demonstration Site Scoring Committee. Organizations on the committee include the U.S. Army Corps of Engineers, the Environmental Security Technology Certification Program, the Strategic Environmental Research and Development Program, the Institute for Defense Analysis, the U.S. Army Environmental Command, and the U.S. Army Aberdeen Test Center.

DTIC

*Ammunition; Explosives Detection; Scoring; Standardization*

## 37

### MECHANICAL ENGINEERING

Includes mechanical devices and equipment; machine elements and processes. For cases where the application of a device or the host vehicle is emphasized see also the specific category where the application or vehicle is treated. For robotics see *63 Cybernetics, Artificial Intelligence, and Robotics*; and *54 Man/System Technology and Life Support*.

**20090034955** Army Tank-Automotive Research and Development Command, Warren, MI USA

**Agile Modeling of Component Connections for Simulation and Design of Complex Vehicle Structures (Slides)**

Castanier, Matthew P; Lamb, David A; Gorsich, David J; Park, Keychun; Apr 2009; 19 pp.; In English; Society of Automotive Engineers (SAE) World Congress, SAE 2009, 20-23 Apr. 2009, Detroit, MI, USA; Original contains color illustrations

Report No.(s): AD-A505130; TARDEC-19805RC; SAE Paper 2009-01-0807; No Copyright; Avail.: Defense Technical Information Center (DTIC)

This briefing looks at how to design vehicles to optimize welding of vehicle components using component mode synthesis to generate reduced order models.

DTIC

*Chutes; Optimization; Simulation; Welded Joints*

**20090035547** California Univ., Riverside, CA, USA

**Development of a Simplified Field Test Method for PM Compliance Screening of Stationary and Portable CI Engines**

Welch, W.; Miller, W.; Feb. 2009; 72 pp.; In English

Contract(s)/Grant(s): CARB-04-330

Report No.(s): PB2009-113643; No Copyright; Avail.: National Technical Information Service (NTIS)

In 1998 the California air Resources Board (CARB) identified diesel exhaust particulate matter (PM) as a toxic air contaminant (TAC) and since then the ARB has been implementing Air Toxic Control Measures (ATCMs) to reduce public exposure to diesel PM. The current method to measure PM emissions from stationary sources is ARB Method 5. However, this method is very time consuming, costly and may not be appropriate for diesel sources with controls. Thus CARB and the University of California, Riverside (UCR) tried to develop a simpler, faster and less expensive field test method for measuring PM emissions from stationary and portable diesel engines; one that local districts could afford and use for enforcement. The



research proposal considered a Simplified Field Test Method (SFTM) using: a single port sampler of raw exhaust, CO<sub>2</sub> emissions as the surrogate of load, and basing total PM mass on the filter catch. Additionally, the research tested two real time PM instruments, including an inexpensive (approx. \$6K) non-filter-based PM measurement method based on laser light scattering photometry (LLSP) and an expensive (approximately \$60K) instrument. Tests of a number of diesel engines compared the PM mass measured with CARB M5, federal reference methods and the proposed Simplified Field Test Method. Results showed the SFTM and the federal reference methods were statistically the same and the M5 was biased high because of the impinger catch. Results showed that field measurements of the PM from a diesel engine with an efficient diesel particulate filter (DPF) installed is difficult for all methods to measure. Further work is needed to improve the precision of the SFTM and the real time PM monitors.

NTIS

*Air Pollution; Diesel Fuels; Field Tests; Particulates; Pollution Monitoring*

**20090035575** Applied Research Associates, Inc., Tyndall AFB, FL USA

**Viral Penetration of High Efficiency Particulate Air (HEPA) Filters**

Helmbuch, Brian K.; Wu, C. Y.; Wander, Joseph D.; September 2009; 39 pp.; In English

Contract(s)/Grant(s): FA4819-07-D-0001; Proj-DODT

Report No.(s): AD-A505315; No Copyright; Avail.: Defense Technical Information Center (DTIC)

High Efficiency Particulate Air (HEPA) filters are the primary technology used for particulate removal in individual and collective protection applications. HEPA filters are commonly thought to be impenetrable, but in fact they are only 99.97% efficient at collecting the most-penetrating particle (approx. 0.3 micrometer). While this is an impressive collection efficiency, HEPA filters may not provide adequate protection for all threats: viruses are submicron in size and have small minimum infectious doses (MID<sub>50</sub>). Thus, an appropriate viral challenge may yield penetration that will lead to infection of personnel. However, the overall particle size (agglomerated viruses and/or viruses attached to inert carriers) will determine the capture efficiency of the HEPA filter. Aerosolized viruses are commonly thought to exist as agglomerates, which would increase the particle size and consequently increase their capture efficiency. However, many of the threat agent viruses can be highly agglomerated and still exist as submicron particles. We have demonstrated that MS2 coli phage aerosols can penetrate Carbon HEPA Aerosol Canisters (CHAC). At a face velocity of 2 cm/sec, a nebulized challenge of approx. 105 viable plaque forming units (PFU) per liter of air results in penetration of approx. 1 - 2 viable PFU per liter of air. We are currently investigating the particle size distribution of the MS2 coli phage aerosol to determine if the challenge is tactically relevant. Preliminary results indicate that 200-300-nanometer particles account for approx. 7.5% of the total number of particles. Our aim is to characterize multiple aerosol conditions and measure the effects on viable penetration. This study will expand our knowledge of the tactical threat posed by viral aerosols to HEPA filter systems.

DTIC

*Aerosols; Agglomeration; Air Filters; Cans; Carbon; Fluid Filters; Particulates; Penetration; Viruses*

**20090035815** NASA Johnson Space Center, Houston, TX, USA

**Effect of Crack Opening on Penetrant Crack Detectability**

Weaver, Devin; [2009]; 25 pp.; In English; Original contains color and black and white illustrations

Report No.(s): JSC-CN-18717; Copyright; Avail.: CASI: A03, Hardcopy

ONLINE: <http://hdl.handle.net/2060/20090035815>

Results: From the testing we were able to determine all the cracks within the test range were detectable or better with developer. Many of the indications after development lost their linearity and gave circular indications. Our tests were performed in a laboratory and our procedure would be difficult in an industrial setting. Conclusions: The 'V' did not significantly affect our ability to detect the POD cracks with fluorescent penetrant. Conduct same experiment with more cracks. The 0.025 and 0.050 POD specimens are clean and documented with the SEM. Conduct water-wash fluorescent penetrant test at EAFB. The poppet cracks are tighter than the POD specimen cracks. Flight FCV poppets: 0.01 mils (0.3 microns) Langley fatigue cracked poppets: 0.02 mils (0.5 microns) POD specimen (post 5 mils): 0.05 mils (1.4 microns) We could not detect cracks in Langley fatigue-cracked poppets with fluorescent penetrant. Investigate inability of penetrant to wet the poppet surface.

Author

*Cracks; Detection; Penetrants; Test Ranges; Fluorescence*

## STRUCTURAL MECHANICS

Includes structural element design, analysis and testing; dynamic responses of structures; weight analysis; fatigue and other structural properties; and mechanical and thermal stresses in structures. For applications see *05 Aircraft Design, Testing and Performance*; and *18 Spacecraft Design, Testing and Performance*.

**20090035749** Office of the Project Manager Force Projection, Warren, MI USA

### **Bridging Team Efforts Supporting Current and Future Forces**

Hornbeck, Brian K.; April 8, 2009; 31 pp.; In English; Original contains color illustrations

Report No.(s): AD-A504945; TARDEC-19782RC; 10782RC; No Copyright; Avail.: Defense Technical Information Center (DTIC)

ONLINE: <http://hdl.handle.net/100.2/ADA504945>

The purpose of this presentation is to provide an overview of the TARDEC Bridging Team's efforts in the research and evaluation of composite bridging technology.

DTIC

*Structural Engineering; Military Technology*

## EARTH RESOURCES AND REMOTE SENSING

Includes remote sensing of earth features, phenomena and resources by aircraft, balloon, rocket, and spacecraft; analysis of remote sensing data and imagery; development of remote sensing products; photogrammetry; and aerial photography. For related instrumentation see *35 Instrumentation and Photography*.

**20090034922** Air Force Research Lab., Mesa, AZ USA

### **Strategy Generalization across Orientation Tasks: Testing a Computational Cognitive Model**

Gunzelmann, Glenn; Jul 1, 2008; 29 pp.; In English

Contract(s)/Grant(s): 02HE01COR; Proj-2313

Report No.(s): AD-A505165; AFRL-RH-AZ-JA-2008-0005; No Copyright; Avail.: Defense Technical Information Center (DTIC)

Humans use their spatial information processing abilities flexibly to facilitate problem solving and decision making in a variety of tasks. This article explores the question of whether a general strategy can be adapted for performing two different spatial orientation tasks by testing the predictions of a computational cognitive model. Human performance was measured on an orientation task requiring participants to identify the location of a target either on a map (find-on-map) or within an egocentric view of a space (find-in-scene). A general strategy instantiated in a computational cognitive model of the find-on-map task, based on the results from Gunzelmann and Anderson (2006), was adapted to perform both tasks and used to generate performance predictions for a new study. The qualitative fit of the model to the human data supports the view that participants were able to tailor a general strategy to the requirements of particular spatial tasks. The quantitative differences between the predictions of the model and the performance of human participants in the new experiment expose individual differences in sample populations. The model provides a means of accounting for those differences and a framework for understanding how human spatial abilities are applied to naturalistic spatial tasks that involve reasoning with maps.

DTIC

*Attitude (Inclination); Cognition; Mathematical Models; Position Sensing; Reading; Space Perception; Targets*

**20090034984** Maryland Univ., College Park, MD, USA

### **Global Characterization of Biomass-Burning Patterns using Satellite Measurements of Fire Radiative Energy**

Ichoku, Charles; Giglio, Louis; Wooster, Martin J.; Remer, Lorraine A.; Remote Sensing of Environment; 2008; Volume 112, pp. 2950-2962; In English; Original contains color illustrations

Contract(s)/Grant(s): NE/C520712/1; Copyright; Avail.: Other Sources

ONLINE: <http://dx.doi.org/10.1016/j.rse.2008.02.009>

Remote sensing is the most practical means of measuring energy release from large open-air biomass burning. Satellite measurement of fire radiative energy (FRE) release rate or power (FRP) enables distinction between fires of different strengths. Based on a 1-km resolution fire data acquired globally by the MODerate-resolution Imaging Spectro-radiometer (MODIS) sensor aboard the Terra and Aqua satellites from 2000 to 2006, instantaneous FRP values ranged between 0.02 MW and 1866



MW, with global daily means ranging between 20 and 40 MW. Regionally, at the Aqua-MODIS afternoon overpass, the mean FRP values for Alaska, Western US, Western Australia, Quebec and the rest of Canada are significantly higher than these global means, with Quebec having the overall highest value of 85 MW. Analysis of regional mean FRP per unit area of land (FRP flux) shows that a peak fire season in certain regions, fires can be responsible for up to 0.2 W/m<sup>2</sup> at peak time of day. Zambia has the highest regional monthly mean FRP flux of approximately 0.045 W/m<sup>2</sup> at peak time of day and season, while the Middle East has the lowest value of approximately 0.0005 W/m<sup>2</sup>. A simple scheme based on FRP has been devised to classify fires into five categories, to facilitate fire rating by strength, similar to earthquakes and hurricanes. The scheme uses MODIS measurements of FRP at 1-km resolution as follows: category 1 (less than 100 MW), category 2 (100 to less than 500 MW), category 3 (500 to less than 1000 MW), category 4 (1000 to less than 1500 MW), category 5 (greater than or equal to 1500 MW). In most regions of the world, over 90% of fires fall into category 1, while only less than 1% fall into each of categories 3 to 5, although these proportions may differ significantly from day to day and by season. The frequency of occurrence of the larger fires is region specific, and could not be explained by ecosystem type alone. Time-series analysis of the proportions of higher category fires based on MODIS measured FRP from 2002 to 2006 does not show any noticeable trend because of the short time period.

Author

*Biomass Burning; Ecosystems; Fires; MODIS (Radiometry); Remote Sensing; Satellite Observation*

**20090035551** NASA Johnson Space Center, Houston, TX, USA

**Expedition Earth and Beyond: Using NASA Data Resources and Integrated Educational Strategies to Promote Authentic Research in the Classroom**

Graffi, Paige Valderrama; Stefanov, William; Willis, Kim; Runco, Sue; [2009]; 1 pp.; In English; American Geophysical Union Conference, 14-18 Dec. 2009, San Francisco, CA, USA

Report No.(s): JSC-CN-18934; Copyright; Avail.: Other Sources; Abstract Only

Teachers in today's classrooms are bound by state required skills, education standards, and high stakes testing. How can they gain skills and confidence to replace units or individual activities with curriculum that incorporates project and inquiry-based learning and promotes authentic research in the classroom? The key to promoting classroom authentic research experiences lies in educator professional development that is structured around teacher needs. The Expedition Earth and Beyond Program is a new geosciences program based at the NASA Johnson Space Center designed to engage, inspire and educate teachers and students in grades 5-14. The program promotes authentic research experiences for classrooms and uses strategies that will help NASA reach its education goals while still allowing educators to teach required standards. Teachers will have access to experts in terrestrial and planetary remote sensing and geoscience; this will enhance their use of content, structure, and relevant experiences to gain the confidence and skills they need to actively engage students in authentic research experiences. Integrated and powerful educational strategies are used to build skills and confidence in teachers. The strategies are as follows: 1) creating Standards-aligned, inquiry-based curricular resources as ready-to-use materials that can be modified by teachers to fit their unique classroom situation; 2) providing ongoing professional development opportunities that focus on active experiences using curricular materials, inquiry-based techniques and expanding content knowledge; 3) connecting science experts to classrooms to deepen content knowledge and provide relevance to classroom activities and real world applications; 4) facilitating students sharing research with their peers and scientists reinforcing their active participation and contributions to research. These components of the Expedition Earth and Beyond Education Program will be enhanced by providing exciting and diverse research opportunities that are inspired by views of Earth from space taken by astronauts on board the International Space Station. The interest and connection to viewing our home planet from space will inevitably spark questions that will drive students to pursue their research investigations, as well as forming a basis for comparisons to the exploration of other planetary bodies in our solar system.

Author

*Education; Earth Observations (From Space); Remote Sensing; Geophysics; International Space Station; Solar System; Terrestrial Planets; Astronauts; Geology*

**20090035580** Air Force Research Lab., Mesa, AZ USA

**Learning to Orient Using a Map Display: Evidence from Eye Tracking**

Gunzelmann, Glenn; Douglass, Scott; Khooshabeh, Peter; Jan. 2008; 5 pp.; In English; Spatial Cognition 2008, 15-19 Sept. 2008, Freiburg, Germany

Contract(s)/Grant(s): AFOSR05HE06COR; Proj-2313

Report No.(s): AD-A505082; No Copyright; Avail.: Defense Technical Information Center (DTIC)

Eight individuals participated in an experiment requiring them to identify the position of a viewer on a map given the

viewer's egocentric perspective of the space. Performance data indicated that response times decreased significantly over the course of the experiment, but accuracy did not improve. An analysis of eye tracking data showed that the speedup in participant performance was primarily a reflection of participants shifting attention between the two perspectives of the space less often. This finding suggests that the improvement resulted from reduced efforts to verify the hypothesized relationship between the views, but that identifying corresponding features remained as a significant challenge.

DTIC

*Cognition; Eye (Anatomy); Eye Movements; Learning; Reading; Space Perception*

## 44

### ENERGY PRODUCTION AND CONVERSION

Includes specific energy conversion systems, e.g., fuel cells; and solar, geothermal, windpower, and waterwave conversion systems; energy storage; and traditional power generators. For technologies related to nuclear energy production see *73 Nuclear Physics*. For related information see also *07 Aircraft Propulsion and Power*; *20 Spacecraft Propulsion and Power*, and *28 Propellants and Fuels*.

**20090035571** Army Tank-Automotive Research and Development Command, Warren, MI USA

#### **TARDEC Technologies (Briefing Charts)**

Coutteau, Chuck; September 30, 2008; 14 pp.; In English; Original contains color illustrations

Report No.(s): AD-A505311; No Copyright; Avail.: Defense Technical Information Center (DTIC)

An overview of TARDEC research related to Ground Vehicle Power and Energy.

DTIC

*Charts*

**20090035573** National Renewable Energy Lab., Golden, CO USA

#### **Solar Leasing for Residential Photovoltaic Systems (Fact Sheet)**

Feb. 01, 2009; 6 pp.; In English

Contract(s)/Grant(s): DE-AC36-99-GO10337

Report No.(s): DE2009-948747; NREL/TP-670-43572; No Copyright; Avail.: Department of Energy Information Bridge

In the past year, the residential solar lease has received significant attention in the solar marketplace, primarily for its ability to leverage two key commercial tax credits for the individual homeowner. However, on January 1, 2009, the \$2,000 cap on the residential investment tax credit (ITC) was lifted. As a result, the expansion of the solar lease model across the USA may be slower than anticipated. Homeowners may revisit the comparison between the solar lease and home-equity financing in light of the change to the ITC. Market conditions have changed, however, and the solar lease provides some distinct advantages. Given the current financial crisis and the decline in home values, qualifying for a home equity loan is more difficult. Also, in response to the removal of the residential ITC cap, state and utility incentive programs have begun to lower their rebates for small photovoltaic systems (<10 kW). These two factors will reduce the negative impact of the ITC revision on the attractiveness of the solar lease model. In addition, solar lease programs require little or no up-front cash to participate as well as the possibility of passing on the operations and maintenance (O&M) responsibilities to a qualified installer. As a result, the solar lease still may be an attractive option for many homeowners who want to install a residential PV system and begin generating solar electricity.

NTIS

*Buildings; Electric Power Plants; Solar Energy Conversion; Solar Houses; Supplying*

## 45

### ENVIRONMENT POLLUTION

Includes atmospheric, water, soil, noise, and thermal pollution.

**20090034900** National Inst. for Occupational Safety and Health, Cincinnati, OH, USA

#### **In-Depth Survey Report: Control Technology for Controlling Worker Exposure to Asphalt Fumes from Roofing Kettles: Kettle Operated Using the FRS-6000(Trade Name) Filtration Unit at Dana Corporation, Columbus, Ohio**

Hayden, C. S.; Oct. 07, 1998; 28 pp.; In English

Report No.(s): PB2009-113675; ECTB-231-11A; No Copyright; Avail.: CASI: [A03](#), Hardcopy

The five-day average of TP, BSF, and PAC exposures were 1.58 mg/m<sup>3</sup>, 1.08 mg/m<sup>3</sup>, and 186 microg/m<sup>3</sup> respectively

to the kettle operators, 0.34 mg/m<sup>3</sup>, 0.12 mg/m<sup>3</sup>, and 22 microg/m<sup>3</sup> respectively in the area and building samples, and 0.77 mg/m<sup>3</sup>, 0.37 mg/m<sup>3</sup>, and 75 microg/m<sup>3</sup> respectively to the roof-level crew. Whether the FRS-6000 filtration unit is used or not, these data show the kettle operator is being exposed to levels of asphalt fume higher than any other roofing worker. This puts the kettle operator at the highest risk of adverse health effects. There was no significant correlation between the square foot of roof replaced (i.e., asphalt used) in a day and the IP, BSF, and PAC exposures to the kettle operator for that day. This is most likely due to the kettle operator loading fewer asphalt kegs (1 or 2) each time the kettle lid is opened during days where usage is low. During high asphalt use days, the kettle operator tends to load more kegs (3 or 4) each time the kettle is opened but does not necessarily open the door more often than on low usage days. This observation is site specific and largely a function of the kettle size used and the kettle operator's work habits.

NTIS

*Asphalt; Exposure; Filtration; Fumes; Industries; Surveys*

**20090034901** National Inst. for Occupational Safety and Health, Cincinnati, OH, USA

**In-Depth Survey Report: Control of Airborne Solvents in a Small Offset Print Shop at Economy Printing, Parchment, Michigan**

Crouch, K. G.; Gressel, M. G.; Sep. 1996; 25 pp.; In English

Report No.(s): PB2009-113674; ECTB-205-12A; No Copyright; Avail.: CASI: [A03](#), Hardcopy

This report contains the results of personal exposure and area sampling for airborne solvent vapors conducted at a small printing establishment during two visits in May 1995. Also included are the sampling methods, the exposure standards, ventilation flow measurements, and some recommendations for follow-up work. Between the visits, a heat recovery ventilator (HRV) containing an air-to-air heat exchanger (United Air Specialists, Inc, Cincinnati, OH) was installed to remove stale air and supply fresh dilution air to the two press rooms. The sampling data provided a basis for evaluating the effectiveness of the HRV in reducing personal exposure levels to the airborne solvent vapors.

NTIS

*Printing; Solvents; Surveys; Waste Energy Utilization*

**20090034902** National Inst. for Occupational Safety and Health, Cincinnati, OH, USA

**In-Depth Survey Report: Recommendations for Control of Egg Containing Dusts and Mists at Siouxpreme Egg Products, Sioux Center, Iowa**

O'Brien, D.; Caplan, P.; Cooper, T.; Todd, W.; Sep. 1988; 28 pp.; In English

Report No.(s): PB2009-113673; ECTB-156-03B; No Copyright; Avail.: CASI: [A03](#), Hardcopy

Aerosol concentrations were highest in the transfer and egg breaking rooms and in the two powdered egg packaging areas. The aerosol in the transfer rooms consisted of an egg mist or a water mist that may be contaminated with egg products. In the transfer area, this aerosol arises from a poorly ventilated egg washer. Recycle of the wash water (which was observed to be heavily contaminated with broken eggs) could result in high exposure to egg protein. Improved washer ventilation should minimize the escape of this aerosol. In the egg breaking area, the mist arises from the use of compressed air to remove egg yolks, egg shells, and egg debris from the egg breaking machines. A program of minimizing compressed air pressure and installation of local exhaust of the egg breaking machines will minimize the release of egg-containing aerosols. Improving the packaging process should reduce exposure to egg dust as well as increase employee productivity.

NTIS

*Dust; Eggs; Food Processing; Industries; Surveys*

**20090034992** Maryland Univ. Baltimore County, Baltimore, MD, USA

**The Influence of European Pollution on Ozone in the Near East and Northern Africa**

Duncan, B. N.; West, J. J.; Yoshida, Y.; Fiore, A. M.; Ziemke, J. R.; Atmospheric Chemistry and Physics; April 25, 2008; Volume 8, pp. 2267-2283; In English; Original contains color illustrations

Contract(s)/Grant(s): MAP/04-0068-0040; Copyright; Avail.: Other Sources

We present a modeling study of the long-range transport of pollution from Europe, showing that European emissions regularly elevate surface ozone by as much as 20 ppbv in summer in northern Africa and the Near East. European emissions cause 50-150 additional violations per year (i.e. above those that would occur without European pollution) of the European health standard for ozone (8-h average greater than 120 micrograms per cubic meters or approximately 60 ppbv) in northern Africa and the Near East. We estimate that European ozone pollution is responsible for 50 000 premature mortalities globally each year, of which the majority occurs outside of Europe itself, including 37% (19 000) in northern Africa and the Near East.

Much of the pollution from Europe is exported southward at low altitudes in summer to the Mediterranean Sea, northern Africa and the Near East, regions with favorable photochemical environments for ozone production. Our results suggest that assessments of the human health benefits of reducing ozone precursor emissions in Europe should include effects outside of Europe, and that comprehensive planning to improve air quality in northern Africa and the Near East likely needs to address European emissions.

Author

*Africa; Air Pollution; Europe; Ozone*

**20090035051** California State Univ., Fresno, CA, USA; California Univ., Irvine, CA, USA

**Dairy Operations: An Evaluation and Comparison of Baseline and Potential Mitigation Practices for Emissions Reductions in the San Joaquin Valley**

Krauter, C.; Blake, D.; May 2009; 87 pp.; In English

Contract(s)/Grant(s): CARB-04-343; PROJ-37411

Report No.(s): PB2009-113644; No Copyright; Avail.: CASI: [A05](#), Hardcopy

In 2002, a study group made up of members from state agencies, academic institutions and the dairy industry was formed by the California Air Resources Board (CARB) and the California Department of Food and Agriculture (CDFA). This group was known as the Dairy Sub-Committee. Their primary goal was to evaluate existing research to estimate the impact of dairy operations on air quality in California. In 2004, the San Joaquin Valley Air Pollution Control District (SJVAPCD) began the process of permitting dairies in their jurisdiction. Many of the Dairy Sub-Committee members became part of the Dairy Permitting Advisory Group (DPAG) of the SJVAPCD. The primary issue addressed by the DPAG process was the uncertainty regarding dairy emissions of the ozone precursors known as Reactive Organic Gas (ROG). ROG was defined as those Volatile Organic Compounds (VOC) that are active in the atmospheric reaction that forms ozone. The Dairy Sub-Committee, noting the lack of current research in California related to this issue, advocated funding and solicitation of proposals to address the problem. This project is one of the responses to that advocacy. The project proposal mandated an advisory group of industry, public agency and research representatives to oversee the study and suggest changes to increase the relevance of the project. The Dairy Sub-committee remained in that role throughout the project.

NTIS

*Air Pollution; Procedures; San Joaquin Valley (CA)*

**20090035552** Joint Fire Science Program, Boise, ID, USA

**Automated System for Evaluation BlueSky Predictions of Smoke Impacts on Community Health and Ecosystems**

Solomon, R.; Mar. 2007; 7 pp.; In English

Report No.(s): PB2009-113637; JFSP-03-1-3-09; No Copyright; Avail.: CASI: [A02](#), Hardcopy

Predictions of smoke impacts on communities and ecosystems are currently being made by the BlueSky smoke forecast system; providing real-time predictions of surface smoke concentrations from prescribed fire, wildfire, and agricultural burn activities. Currently operational in the Pacific Northwest, BlueSky has already a demonstrated success regarding what inter-agency collaboration can accomplish. A critical component of BlueSky that needed to be addressed was the development of an automated verification system to evaluate predicted impacts from smoke on communities and ecosystems. A verification system is necessary because land managers need to evaluate their burn decisions against potential National Ambient Air Quality Standard (NAAQS) exceedences. To achieve this, the verification of predicted concentrations against observed must be provided in a timely (i.e. real-time) manner. Thus the original proposal included two major components: (1) improving existing monitoring systems to make the data available in real-time (e.g., in a manner similar to the Washington State Department of Ecology, WSDOE); and (2) implementing a software system that compares these observational data with the smoke concentration fields predicted by BlueSky.

NTIS

*Ecosystems; Health; Smoke*

**20090035556** Air Resource Specialists, Inc., Fort Collins, CO, USA

**Annual Data Summary: Cowpens National Battlefield National Park Service Gaseous Air Pollutant Monitoring Network**

Jan. 2000; 38 pp.; In English

Report No.(s): PB2009-114230; DINPS-D-35; No Copyright; Avail.: National Technical Information Service (NTIS)

Gaseous air pollutants, including ozone and sulfur dioxide are of concern to the National Park Service (NPS). Pollutants

like these can affect park unit biological resources as well as the health of park unit residents and visitors. The NPS established a gaseous pollutant monitoring program for several pollutants linked to the effects on NPS resources. This program was designed to meet certain resource management objectives. The primary objective of this monitoring program is to establish the status and trends of the park unit air quality conditions and to determine if a park unit is exceeding the National Ambient Air Quality Standards established by the U.S Environmental Protection Agency (EPA) to protect public health and welfare. In addition, such monitoring is designed to detect changes or trends in pollution levels over time.

NTIS

*Air Pollution; Pollution Monitoring; Air Quality; Atmospheric Effects; Environment Protection; Environmental Quality*

**20090035758** Department of Energy, Richland, WA USA

**Technology Readiness Assessment of a Large DOE Waste Processing Facility**

Alexander, Don; Holton, Langdon; Sutter, Herb; September 12, 2007; 52 pp.; In English; 2007 Technology Maturity Conference (TMC), 11-13 Sep. 2007, Virginia Beach, VA, USA; Original contains color and black and white illustrations Report No.(s): AD-A504565; No Copyright; Avail.: Defense Technical Information Center (DTIC)

ONLINE: <http://hdl.handle.net/100.2/ADA504565>

This briefing looks at the design and construction of the Hanford Waste Treatment Plant (WTP). When completed, Hanford's WTP will be the world's largest radioactive waste treatment plant. Facilities will include Pretreatment (PT) Facility, Low Activity Waste (LAW) Vitrification Facility, High Level Waste (HLW) Vitrification Facility, and Analytical Laboratory. Three Technology Readiness Assessments have been completed on the WTP and are discussed.

DTIC

*Radioactive Wastes; Technology Assessment; Waste Disposal*

**20090035794** NASA Goddard Space Flight Center, Greenbelt, MD, USA

**Validation of SO<sub>2</sub> Retrievals from the Ozone Monitoring Instrument over NE China**

Krotkov, Nickolay A.; McClure, Brittany; Dickerson, Russell R.; Carn, Simon A.; Li, Can; Bhartia, Pawan K.; Yang, Kai; Krueger, Arlin J.; Li, Zhanqing; Levelt, Pieter F.; Chen, Hongbin; Wang, Pucai; Lu, Daren; Journal of Geophysical Research - Atmospheres; June 2008; ISSN 0148-0227; Volume 113; 1 pp.; In English; Copyright; Avail.: Other Sources

ONLINE: <http://dx.doi.org/10.1029/2007JD008818>

The Dutch-Finnish Ozone Monitoring Instrument (OMI) launched on the NASA Aura satellite in July 2004 offers unprecedented spatial resolution, coupled with contiguous daily global coverage, for space-based UV measurements of sulfur dioxide (SO<sub>2</sub>). We present a first validation of the OMI SO<sub>2</sub> data with in situ aircraft measurements in NE China in April 2005. The study demonstrates that OMI can distinguish between background SO<sub>2</sub> conditions and heavy pollution on a daily basis. The noise (expressed as the standard deviation,  $\sigma$ ) is approximately 1.5 DU (Dobson units; 1 DU =  $2.69 \times 10^{16}$  molecules/cm<sup>2</sup>) for instantaneous field of view boundary layer (PBL) SO<sub>2</sub> data. Temporal and spatial averaging can reduce the noise to  $\sigma$  approximately 0.3 DU over a remote region of the South Pacific; the long-term average over this remote location was within 0.1 DU of zero. Under polluted conditions collection 2 OMI data are higher than aircraft measurements by a factor of two. Improved calibrations of the radiance and irradiance data (collection 3) result in better agreement with aircraft measurements on polluted days. The air mass corrected collection 3 data still show positive bias and sensitivity to UV absorbing aerosols. The difference between the in situ data and the OMI SO<sub>2</sub> measurements within 30 km of the aircraft profiles was about 1 DU, equivalent to approximately 5 ppb from 0 to 3000 m altitude. Quantifying the SO<sub>2</sub> and aerosol profiles and spectral dependence of aerosol absorption between 310 and 330 nm are critical for an accurate estimate of SO<sub>2</sub> from satellite UV measurements.

Author

*Sulfur Dioxides; Air Pollution; Satellite Observation; Remote Sensing*

**20090036316** Air Resource Specialists, Inc., Fort Collins, CO, USA

**Annual Data Summary: Cowpens National Battlefield, 2001. National Park Service Gaseous Air Pollutant Monitoring Network**

January 2001; 38 pp.; In English

Report No.(s): PB2009-114231; DINPS-D-37; No Copyright; Avail.: National Technical Information Service (NTIS)

Gaseous air pollutants, including ozone and sulfur dioxide are of concern to the National Park Service (NPS). Pollutants like these can affect park unit biological resources as well as the health of park unit residents and visitors. The NPS established a gaseous pollutant monitoring program for several pollutants linked to the effects on NPS resources. This program was



designed to meet certain resource management objectives. The primary objective of this monitoring program is to establish the status and trends of the park unit air quality conditions and to determine if a park unit is exceeding the National Ambient Air Quality Standards established by the U.S Environmental Protection Agency (EPA) to protect public health and welfare. In addition, such monitoring is designed to detect changes or trends in pollution levels over time.

NTIS

*Air Pollution; National Parks; Pollution Monitoring; Air Quality*

## 46

### GEOPHYSICS

Includes Earth structure and dynamics, aeronomy; upper and lower atmosphere studies; ionospheric and magnetospheric physics; and geomagnetism. For related information see *47 Meteorology and Climatology*; and *93 Space Radiation*.

**20090034916** Massachusetts Inst. of Tech., Cambridge, MA USA

#### **Seismic Tomography of the Arabian-Eurasian Collision Zone and Surrounding Areas**

Toksoz, M N; Van der Hilst, Robert D; Sun, Youshun; Zhang, Haijiang; Zeng, Xiangfang; Pei, Shunping; Sep 30, 2009; 11 pp.; In English; Original contains color illustrations

Contract(s)/Grant(s): FA8718-07-C-0001; BAA07-09; Proj-1010

Report No.(s): AD-A505255; No Copyright; Avail.: Defense Technical Information Center (DTIC)

The objectives of this study are to determine P- and S-wave velocity structures in the crust and upper mantle, and to characterize seismic wave propagation in the Arabian-Eurasian collision zone and surrounding areas, including Iran, Arabia, Eastern Turkey, and the Caucasus. The Arabian-Eurasian plate boundary is a complex tectonic zone shaped by continent-continent collision processes. In recent years the number of seismic stations has increased greatly in the region because of expanded seismic networks in Azerbaijan, Turkey, Iran and the Gulf countries. We have been collecting the data through cooperation with individual network operators and the countries. Considerable effort has been directed to collecting P and S seismic arrival time data recorded by the new networks in Iran. Using arrival time data we obtained Pn and Sn images of the uppermost mantle beneath Arabian-Eurasian Collision Zone t-J including Iran, the Caucasus, and the Arabian Peninsula by tomographic inversion. With the newly obtained data from Central Asia incorporated into our database, we improved the ray coverage in our study region. Our current plan is to utilize the new data from Iran to improve the velocity models. This effort will include tomographic inversions for velocity structure in the crust and upper mantle, relocation of all events, and the validation of models using synthetic seismograms to fit available broad-band waveforms.

DTIC

*Collisions; Seismic Waves; Tomography; Wave Propagation*

**20090034917** California Univ., San Diego, La Jolla, CA USA

#### **Estimating Bodywave Arrivals and Attenuation from Seismic Noise**

Gerstoft, Peter; Zhang, Jian; Taylor, Steven R; Sep 30, 2009; 12 pp.; In English; Original contains color illustrations

Contract(s)/Grant(s): FA8718-07-C-0005; Proj-1010

Report No.(s): AD-A505261; No Copyright; Avail.: Defense Technical Information Center (DTIC)

This paper investigates the utility of computing Time-Domain Green's Functions (TDGF) to be used for estimating velocity and attenuation structure for the purposes of nuclear explosion monitoring over local and near-regional distances. We have focused on two topics: Earth's background vibrations at frequencies below about 0.5 Hz have been attributed to ocean-wave energy coupling into the ground and propagating as surface waves and P waves (compressional waves deep within the Earth). However, the origin and nature of seismic noise on land at frequencies around 1 Hz has not yet been well studied. Using array beamforming, we analyze the seismic noise fields at two remote sites (Parkfield and Mojave Deserts) in California, for durations of one and six months respectively. We find that (1) the seismic background noise at about 0.6-2 Hz consists of a significant amount of continuous P waves originating offshore, and (2) the power of the f-wave noise is highly correlated with the offshore wind speed, demonstrating that these high-frequency P waves are excited by distant ocean winds. We present a methodology to obtain frequency-dependent relative site amplification factors using ambient seismic noise. We treat a seismic network or array as a forced damped harmonic oscillator system where each station responds to a forcing function obtained from frequency-wavenumber beams of the ambient noise field. Taken over long time periods, each station responds to the forcing function showing a frequency-dependent resonance peak whose amplitude and spectral width depends upon the elastic and an elastic properties of the underlying medium. Our results are encouraging in that hard rock sites generally show

narrower resonance peaks with reduced amplitudes relative to soft rock sites in sedimentary basins. There is also a tendency for spectral peaks to shift to higher frequencies and become more asymmetric as the site amplification increases.

DTIC

*Attenuation; Background Noise; Estimating; Nuclear Explosions; Seismic Waves; Tomography*

**20090035564** Illinois Univ. at Urbana-Champaign, Urbana, IL USA

**Surface Wave Dispersion Measurements and Tomography from Ambient Seismic Noise Correlation in China**

Song, Xiaodong; Xu, Zhen; Sun, Xinlei; Zheng, Sihua; Yang, Yingjie; Ritzwoller, Michael H.; September 30, 2009; 10 pp.;

In English; Original contains color illustrations

Contract(s)/Grant(s): FA8718-07-C-0006; Proj-1010

Report No.(s): AD-A505295; No Copyright; Avail.: Defense Technical Information Center (DTIC)

We perform ambient noise tomography of China using the data from the China National Seismic Network and surrounding global and PASSCAL stations. The results so far are summarized below. (1) Dispersion measurements and tomography. For most of the station pairs, we retrieve good Rayleigh waveforms from ambient noise correlations using 18-months of continuous data at all distance ranges across the entire region (over 5000 km) and for periods from 70 s down to about 8 s. We obtain Rayleigh wave group and phase velocity dispersion measurements using a frequency-time analysis method and invert for Rayleigh dispersion maps for periods from 8 to 60 s. The dispersion maps correlate nicely with surface geology. (2) Error estimates using bootstrap analysis. A major feature of the ambient noise method is that the whole process is completely repeatable with different time segments, which make it possible to evaluate the uncertainties. We adopt a bootstrap method to quantify the errors in the Rayleigh wave group velocity dispersion measurements and the tomographic maps. Most of the pairs show similar dispersion curves between different runs and small standard deviations, indicating good data quality and convergence of the Green function. Group velocity at long period end generally has a larger error, which is consistent with the notion that the long period needs longer time to converge. The best retrieved periods are from 10 to 30 s with the optimal period of around 15 to 20 s. Pairs with large errors do not depend on the orientations of the paths or the locations of the stations. Rather, they are associated with a few stations with large average standard errors. The likely causes are missing data and poor instrumentation (or site conditions). Where ray coverage is good, there is only subtle difference in tomography maps between different runs, suggesting that our solution is very stable.

DTIC

*Ambience; China; Dispersing; Noise (Sound); Rayleigh Waves; Surface Waves; Tomography; Wave Dispersion*

**20090035774** NASA Goddard Space Flight Center, Greenbelt, MD, USA

**The Governing Processes and Timescales of Stratosphere-to-Troposphere Transport and its Contribution to Ozone in the Arctic Troposphere**

Liang, Q.; Douglass, A. R.; Duncan, B. N.; Stolarski, R. S.; Witte, J. C.; Atmospheric Chemistry and Physics; May 11, 2009; Volume 9, pp. 3011-2025; In English; Copyright; Avail.: Other Sources

We used the seasonality of a combination of atmospheric trace gases and idealized tracers to examine stratosphere-to-troposphere transport and its influence on tropospheric composition in the Arctic. Maximum stratosphere-to-troposphere transport of CFCs and O<sub>3</sub> occurs in April as driven by the Brewer-Dobson circulation. Stratosphere-troposphere exchange (STE) occurs predominantly between 40 deg N to 80 deg N with stratospheric influx in the mid-latitudes (30-70 deg N) accounting for 67.81 percent of the air of stratospheric origin in the Northern Hemisphere extratropical troposphere. Transport from the lower stratosphere to the lower troposphere (LT) takes three months on average, one month to cross the tropopause, the second month to travel from the upper troposphere (UT) to the middle troposphere (MT), and the third month to reach the LT. During downward transport, the seasonality of a trace gas can be greatly impacted by wet removal and chemistry. A comparison of idealized tracers with varying lifetimes suggests that when initialized with the same concentrations and seasonal cycles at the tropopause, trace gases that have shorter lifetimes display lower concentrations, smaller amplitudes, and earlier seasonal maxima during transport to the LT. STE contributes to O<sub>3</sub> in the Arctic troposphere directly from the transport of O<sub>3</sub> and indirectly from the transport of NO<sub>y</sub>. Direct transport of O<sub>3</sub> from the stratosphere accounts for 78 percent of O<sub>3</sub> in the Arctic UT with maximum contributions occurring from March to May. The stratospheric contribution decreases significantly in the MT/LT (20.25 percent of total O<sub>3</sub>) and shows a very weak March-April maximum. Our NO<sub>x</sub> budget analysis in the Arctic UT shows that during spring and summer, the stratospheric injection of NO<sub>y</sub>-rich air increases NO<sub>x</sub> concentrations above the 20 pptv threshold level, thereby shifting the Arctic UT from a regime of net photochemical ozone loss to one of net production with rates as high as +16 ppbv/month.

Author

*Troposphere; Atmospheric Circulation; Stratosphere; Ozone*

Includes weather observation forecasting and modification.

**20090034976** NASA Goddard Space Flight Center, Greenbelt, MD, USA

**Precipitating Snow Retrievals from Combined Airborne Cloud Radar and Millimeter-Wave Radiometer Observations**

Grecu, Mircea; Olson, William S.; Journal of Applied Meteorology and Climatology; [2008]; Volume 47, Issue 6, pp. 1634-1650; In English; Copyright; Avail.: Other Sources; Abstract Only

ONLINE: <http://dx.doi.org/10.1175/2007JAMC1728.1>

An algorithm for retrieving snow over oceans from combined cloud radar and millimeter-wave radiometer observations is developed. The algorithm involves the use of physical models to simulate cloud radar and millimeter-wave radiometer observations from basic atmospheric variables such as hydrometeor content, temperature, and relative humidity profiles and is based on an optimal estimation technique to retrieve these variables from actual observations. A high-resolution simulation of a lake-effect snowstorm by a cloud-resolving model is used to test the algorithm. That is, synthetic observations are generated from the output of the cloud numerical model, and the retrieval algorithm is applied to the synthetic data. The algorithm performance is assessed by comparing the retrievals with the reference variables used in synthesizing the observations. The synthetic observation experiment indicates good performance of the retrieval algorithm. The algorithm is also applied to real observations from the Wakasa Bay field experiment that took place over the Sea of Japan in January and February 2003. The application of the retrieval algorithm to data from the field experiment yields snow estimates that are consistent with both the cloud radar and radiometer observations.

Author

*Millimeter Waves; Clouds (Meteorology); Radar Tracking; Algorithms; Snowstorms; Atmospheric Models; Atmospheric Temperature*

**20090034979** NASA Goddard Space Flight Center, Greenbelt, MD, USA

**Optical-Microphysical Cirrus Model**

Reichardt, J.; Reichardt, S.; Lin, R.-F.; Hess, M.; McGee, T. J.; Starr, D. O.; Journal of Geophysical Research - Atmospheres; November 2008; ISSN 0148-0227; Volume 113; 1 pp.; In English; Copyright; Avail.: Other Sources; Abstract Only

ONLINE: <http://dx.doi.org/10.1029/2008JD010071>

A model is presented that permits the simulation of the optical properties of cirrus clouds as measured with depolarization Raman lidars. It comprises a one-dimensional cirrus model with explicit microphysics and an optical module that transforms the microphysical model output to cloud and particle optical properties. The optical model takes into account scattering by randomly oriented or horizontally aligned planar and columnar monocrystals and polycrystals. Key cloud properties such as the fraction of plate-like particles and the number of basic crystals per polycrystal are parameterized in terms of the ambient temperature, the nucleation temperature, or the mass of the particles. The optical-microphysical model is used to simulate the lidar measurement of a synoptically forced cirrostratus in a first case study. It turns out that a cirrus cloud consisting of only monocrystals in random orientation is too simple a model scenario to explain the observations. However, good agreement between simulation and observation is reached when the formation of polycrystals or the horizontal alignment of monocrystals is permitted. Moreover, the model results show that plate fraction and morphological complexity are best parameterized in terms of particle mass, or ambient temperature which indicates that the ambient conditions affect cirrus optical properties more than those during particle formation. Furthermore, the modeled profiles of particle shape and size are in excellent agreement with in situ and laboratory studies, i.e., (partly oriented) polycrystalline particles with mainly planar basic crystals in the cloud bottom layer, and monocrystals above, with the fraction of columns increasing and the shape and size of the particles changing from large thin plates and long columns to small, more isometric crystals from cloud center to top. The findings of this case study corroborate the microphysical interpretation of cirrus measurements with lidar as suggested previously.

Author

*Optical Properties; Cirrus Clouds; Cloud Cover; Cloud Physics; Optical Radar; Radar Measurement; Mathematical Models*

**20090034982** NASA Goddard Space Flight Center, Greenbelt, MD, USA

**Raindrop Size Distribution Measurements in Tropical Cyclones**

Tokay, Ali; Bashor, Paul G.; Habib, Emad; Kasparis, Takis; Monthly Weather Review; May 2008; Volume 136, Issue 5, pp. 1669-1685; In English; Copyright; Avail.: Other Sources

ONLINE: <http://dx.doi.org/10.1175/2007MWR2122.1>

Characteristics of the raindrop size distribution in seven tropical cyclones have been studied through impact-type

disdrometer measurements at three different sites during the 2004-06 Atlantic hurricane seasons. One of the cyclones has been observed at two different sites. High concentrations of small and/or midsize drops were observed in the presence or absence of large drops. Even in the presence of large drops, the maximum drop diameter rarely exceeded 4 mm. These characteristics of raindrop size distribution were observed in all stages of tropical cyclones, unless the storm was in the extratropical stage where the tropical cyclone and a midlatitude frontal system had merged. The presence of relatively high concentrations of large drops in extratropical cyclones resembled the size distribution in continental thunderstorms. The integral rain parameters of drop concentration, liquid water content, and rain rate at fixed reflectivity were therefore lower in extratropical cyclones than in tropical cyclones. In tropical cyclones, at a disdrometer-calculated reflectivity of 40 dBZ, the number concentration was 700 plus or minus 100 drops  $m^{-3}$ , while the liquid water content and rain rate were 0.90 plus or minus 0.05 g  $m^{-3}$  and 18.5 plus or minus 0.5 mm  $h^{-1}$ , respectively. The mean mass diameter, on the other hand, was 1.67 plus or minus 0.3 mm. The comparison of raindrop size distributions between Atlantic tropical cyclones and storms that occurred in the central tropical Pacific island of Roi-Namur revealed that the number density is slightly shifted toward smaller drops, resulting in higher-integral rain parameters and lower mean mass and maximum drop diameters at the latter site. Considering parameterization of the raindrop size distribution in tropical cyclones, characteristics of the normalized gamma distribution parameters were examined with respect to reflectivity. The mean mass diameter increased rapidly with reflectivity, while the normalized intercept parameter had an increasing trend with reflectivity. The shape parameter, on the other hand, decreased in a reflectivity range from 10 to 20 dBZ and remained steady at higher reflectivities. Considering the repeatability of the characteristics of the raindrop size distribution, a second impact disdrometer that was located 5.3 km away from the primary site in Wallops Island, Virginia, had similar size spectra in selected tropical cyclones.

Author

*Cyclones; Raindrops; Tropical Regions; Hurricanes; Thunderstorms; Tropical Storms*

**20090034983** Maryland Univ. Baltimore County, Baltimore, MD, USA

#### **On the Sensitivity of Atmospheric Ensembles to Cloud Microphysics in Long-Term Cloud-Resolving Model Simulations**

Zeng, Xiping; Tao, Wei-Kuo; Lang, Stephen; Hou, Arthur Y.; Zhang, Minghua; Simpson, Joanne; Journal of the Meteorological Society of Japan; November 2008; Volume 86A, pp. 45-65; In English

Contract(s)/Grant(s): DE-AI02-04ER63755; Copyright; Avail.: Other Sources

ONLINE: <http://dx.doi.org/10.2151/jmsj.86A.45>

Month-long large-scale forcing data from two field campaigns are used to drive a cloud-resolving model (CRM) and produce ensemble simulations of clouds and precipitation. Observational data are then used to evaluate the model results. To improve the model results, a new parameterization of the Bergeron process is proposed that incorporates the number concentration of ice nuclei (IN). Numerical simulations reveal that atmospheric ensembles are sensitive to IN concentration and ice crystal multiplication. Two- (2D) and three-dimensional (3D) simulations are carried out to address the sensitivity of atmospheric ensembles to model dimensionality. It is found that the ensembles with high IN concentration are more sensitive to dimensionality than those with low IN concentration. Both the analytic solutions of linear dry models and the CRM output show that there are more convective cores with stronger updrafts in 3D simulations than in 2D, which explains the differing sensitivity of the ensembles to dimensionality at different IN concentrations.

Author

*Cloud Physics; Clouds (Meteorology); Ice Nuclei; Parameterization; Sensitivity; Simulation*

**20090034985** Weizmann Inst. of Science, Rehovot, Israel

#### **Smoke Invigoration Versus Inhibition of Clouds over the Amazon**

Koren, Ilan; Martins, J. Vanderlei; Lorraine, A. Remer; Afargan, Hila; Science; August 15, 2008; Volume 321, No. 5981, pp. 946-949; In English; Copyright; Avail.: Other Sources

ONLINE: <http://dx.doi.org/10.1126/science.1159185>

The effect of anthropogenic aerosols on clouds is one of the most important and least understood aspects of human-induced climate change. Small changes in the amount of cloud coverage can produce a climate forcing equivalent in magnitude and opposite in sign to that caused by anthropogenic greenhouse gases, and changes in cloud height can shift the effect of clouds from cooling to warming. Focusing on the Amazon, we show a smooth transition between two opposing effects of aerosols on clouds: the microphysical and the radiative. We show how a feedback between the optical properties of aerosols and the cloud fraction can modify the aerosol forcing, changing the total radiative energy and redistributing it over the atmospheric column.

Author

*Climate Change; Cloud Height Indicators; Man Environment Interactions; Smoke; Greenhouse Effect*



**20090034989** NASA Goddard Space Flight Center, Greenbelt, MD, USA

**Radiative Susceptibility of Cloudy Atmospheres to Droplet Number Perturbations: 1. Theoretical Analysis and Examples from MODIS**

Platnick, Steven; Oreopoulos, Lazaros; Journal of Geophysical Research Atmospheres; July 25, 2008; Volume 113; 1 pp.; In English; Copyright; Avail.: Other Sources

ONLINE: <http://dx.doi.org/10.1029/2007JD009654>

Theoretical and satellite-based assessments of the sensitivity of broadband shortwave radiative fluxes in cloudy atmospheres to small perturbations in the cloud droplet number concentration (N) of liquid water clouds under constant water conditions are performed. Two approaches to study this sensitivity are adopted: absolute increases in N, for which the radiative response is referred to as absolute cloud susceptibility, and relative increases in N or relative cloud susceptibility. Estimating the former is more challenging as it requires an assumed value for either cloud liquid water content or geometrical thickness; both susceptibilities require an assumed relationship between the droplet volume and effective radius. Expanding upon previous susceptibility studies, present radiative calculations include the effect of AN perturbations on droplet asymmetry parameter and single-scattering albedo, in addition to extinction. Absolute cloud susceptibility has a strong nonlinear dependence on the droplet effective radius as expected, while relative cloud susceptibility is primarily dependent on optical thickness. Molecular absorption and reflecting surfaces both reduce the relative contribution of the cloud to the top-of-atmosphere (TOA) flux and therefore also reduce the TOA albedo susceptibility. Transmittance susceptibilities are negative with absolute values similar to albedo susceptibility, while atmospheric absorptance susceptibilities are about an order of magnitude smaller than albedo susceptibilities and can be either positive or negative. Observation-based susceptibility calculations are derived from MODIS pixel-level retrievals of liquid water cloud optical thickness, effective radius, and cloud top temperature; two data granule examples are shown. Susceptibility quantifies the aerosol indirect effect sensitivity in a way that can be easily computed from model fields. As such, susceptibilities derived from MODIS observations provide a higher-order test of model cloud properties used for indirect effect studies. MODIS-derived global distributions of cloud susceptibility and radiative forcing calculations are presented in a companion paper.

Author

*Moisture Content; Drops (Liquids); Cloud Physics; Perturbation; MODIS (Radiometry); Estimating; Molecular Absorption; Aerosols*

**20090034991** Maryland Univ. Baltimore County, Baltimore, MD, USA

**Radiative Susceptibility of Cloudy Atmospheres to Droplet Number Perturbations: 2. Global analysis from MODIS**

Oreopoulos, Lazaros; Platnick, Steven; Journal of Geophysical Research; July 25, 2008; Volume 113; 1 pp.; In English; Copyright; Avail.: Other Sources

ONLINE: <http://dx.doi.org/10.1029/2007JD009655>

Global distributions of albedo susceptibility for areas covered by liquid clouds are presented for 4 months in 2005. The susceptibility estimates are based on expanded definitions presented in a companion paper and include relative cloud droplet number concentration (CDNC) changes, perturbations in cloud droplet asymmetry parameter and single-scattering albedo, atmospheric/surface effects, and incorporation of the full solar spectrum. The cloud properties (optical thickness and effective radius) used as input in the susceptibility calculations come from MODIS Terra and Aqua Collection 5 gridded data. Geographical distributions of susceptibility corresponding to absolute ( absolute cloud susceptibility ) and relative ( relative cloud susceptibility ) CDNC changes are markedly different indicating that the detailed nature of the cloud microphysical perturbation is important for determining the radiative forcing associated with the first indirect aerosol effect. However, both types of susceptibility exhibit common characteristics such as significant reductions when perturbations in single-scattering properties are omitted, significant increases when atmospheric absorption and surface albedo effects are ignored, and the tendency to decrease with latitude, to be higher over ocean than over land, and to be statistically similar between the morning and afternoon MODIS overpasses. The satellite-based susceptibility analysis helps elucidate the role of present-day cloud and land surface properties in indirect aerosol forcing responses. Our realistic yet moderate CDNC perturbations yield forcings on the order of 1-2 W/sq m for cloud optical property distributions and land surface spectral albedos observed by MODIS. Since susceptibilities can potentially be computed from model fields, these results have practical application in assessing the reasonableness of model-generated estimates of the aerosol indirect radiative forcing.

Author

*Atmospheric Effects; Cloud Physics; MODIS (Radiometry); Imaging Spectrometers; Drops (Liquids); Perturbation; Atmospheric Attenuation*



**20090034993** NASA Goddard Space Flight Center, Greenbelt, MD, USA

**Stratospheric Semi-Decadal Oscillations in NCEP Data**

Mayr, H. G.; Mengel, J. G.; Huang, F. T.; Talaat, E. R.; Nash, E. R.; Reddy, C. A.; *Annales Geophysicae*; August 1, 2008; Volume 26, pp. 2143-2157; In English; Original contains black and white illustrations; Copyright; Avail.: Other Sources

An analysis of the National Centers for Environmental Prediction (NCEP)/National Center for Atmospheric Research (NCAR) data is presented to provide a more complete description of the stratospheric 5-year semi-decadal (SD) oscillation (Mayr et al., 2007). The zonal-mean temperature and zonal wind data from the Atmospheric Research R-1 analysis are employed, covering the years from 1962 to 2002 in the altitude range from 10 to 30km. For diagnostic purposes, the data are separated into the hemispherically symmetric and anti-symmetric components, and spectral analysis is applied to identify the signatures of the SD oscillations. Through the synthesis or filtering of spectral features, the SD modulations of the annual oscillation (AO) and quasi-biennial oscillation (QBO) are delineated. In agreement with the earlier findings, the magnitude of the SD oscillation is more pronounced when the 30-month QBO dominates during the years from 1975 to 1995. This is consistent with results from a numerical model, which shows that such a QBO generates the SD oscillation through interaction with the 12-month AO. In the zonal winds, the SD oscillation in the NCEP data is confined to equatorial latitudes, where it modulates the symmetric AO and QBO by about 5 m/s below 30 km. In the temperature data, the effect is also seen around the equator, but it is much larger at polar latitudes where the SD oscillation produces variations as large as 2 K. Our data analysis indicates that the SD oscillation is mainly hemispherically symmetric, and it appears to originate at equatorial latitudes where most of the energy resides.

Author

*Atmospheric Temperature; Wind Measurement; Periodic Variations; Confinement; Spectrum Analysis; Wind (Meteorology); Quasi-Biennial Oscillation; Temperature Effects*

**20090034994** Maryland Univ., College Park, MD, USA

**A New Technique for Retrieval of Tropospheric and Stratospheric Ozone Profiles using Sky Radiance Measurements at Multiple View Angles: Application to a Brewer Spectrometer**

Tzortziou, Maria; Krotkov, Nikolay A.; Cede, Alexander; Herman, Jay R.; Vasilkov, Alexander; *Journal of Geophysical Research*; March 27, 2008; Vol. 113, D06304; 1 pp.; In English; Copyright; Avail.: Other Sources

ONLINE: <http://dx.doi.org/10.1029/2007JD009093>

This paper describes and applies a new technique for retrieving diurnal variability in tropospheric ozone vertical distribution using ground-based measurements of ultraviolet sky radiances. The measured radiances are obtained by a polarization-insensitive modified Brewer double spectrometer located at Goddard Space Flight Center, in Greenbelt, Maryland, USA. Results demonstrate that the Brewer angular (0-72deg viewing zenith angle) and spectral (303-320 nm) measurements of sky radiance in the solar principal plane provide sufficient information to derive tropospheric ozone diurnal variability. In addition, the Brewer measurements provide stratospheric ozone vertical distributions at least twice per day near sunrise and sunset. Frequent measurements of total column ozone amounts from direct-sun observations are used as constraints in the retrieval. The vertical ozone profile resolution is shown in terms of averaging kernels to yield at least four points in the troposphere-low stratosphere, including good information in Umkehr layer 0 (0-5 km). The focus of this paper is on the derivation of stratospheric and tropospheric ozone profiles using both simulated and measured radiances. We briefly discuss the necessary modifications of the Brewer spectrometer that were used to eliminate instrumental polarization sensitivity so that accurate sky radiances can be obtained in the presence of strong Rayleigh scattering and aerosols. The results demonstrate that including a site-specific and time-dependent aerosol correction, based on Brewer direct-sun observations of aerosol optical thickness, is critical to minimize the sky radiance residuals as a function of observing angle in the optimal estimation inversion algorithm and improve the accuracy of the retrieved ozone profile.

Author

*Atmospheric Composition; Diurnal Variations; Rayleigh Scattering; Time Dependence; Troposphere; Stratosphere*

**20090034995** Science Systems and Applications, Inc., Lanham, MD, USA

**Evaluation of the OMI Cloud Pressures Derived from Rotational Raman Scattering by Comparisons with other Satellite Data and Radiative Transfer Simulations**

Vasilkov, Alexander; Joiner, Joanna; Spurr, Robert; Bhartia, Pawan K.; Levelt, Pieter; Stephens, Graeme; *Journal of Geophysical Research*; May 09, 2009; Volume 113, D15S19; 1 pp.; In English; Copyright; Avail.: Other Sources

ONLINE: <http://dx.doi.org/10.1029/2007JD008689>

In this paper we examine differences between cloud pressures retrieved from the Ozone Monitoring Instrument (OMI) using the ultraviolet rotational Raman scattering (RRS) algorithm and those from the thermal infrared (IR) Aqua/MODIS.

Several cloud data sets are currently being used in OMI trace gas retrieval algorithms including climatologies based on IR measurements and simultaneous cloud parameters derived from OMI. From a validation perspective, it is important to understand the OMI retrieved cloud parameters and how they differ with those derived from the IR. To this end, we perform radiative transfer calculations to simulate the effects of different geophysical conditions on the OMI RRS cloud pressure retrievals. We also quantify errors related to the use of the Mixed Lambert-Equivalent Reflectivity (MLER) concept as currently implemented of the OMI algorithms. Using properties from the Cloudsat radar and MODIS, we show that radiative transfer calculations support the following: (1) The MLER model is adequate for single-layer optically thick, geometrically thin clouds, but can produce significant errors in estimated cloud pressure for optically thin clouds. (2) In a two-layer cloud, the RRS algorithm may retrieve a cloud pressure that is either between the two cloud decks or even beneath the top of the lower cloud deck because of scattering between the cloud layers; the retrieved pressure depends upon the viewing geometry and the optical depth of the upper cloud deck. (3) Absorbing aerosol in and above a cloud can produce significant errors in the retrieved cloud pressure. (4) The retrieved RRS effective pressure for a deep convective cloud will be significantly higher than the physical cloud top pressure derived with thermal IR.

Author

*Cloud Cover; Atmospheric Composition; MODIS (Radiometry); Raman Spectra; Trace Contaminants; Radiative Transfer; Ozone; CloudSat; Climatology*

**20090034996** Science Systems and Applications, Inc., Lanham, MD, USA

**The Quasi-biennial Oscillation and Annual Variations in Tropical Ozone from SHADOZ and HALOE**

Witte, J. C.; Schoeberl, M. R.; Douglass, A. R.; Thompson, A. M.; Atmospheric Chemistry and Physics; July 24, 2008; Volume 8, pp. 3929-3936; In English; Original contains color illustrations; Copyright; Avail.: Other Sources

We examine the tropical ozone mixing ratio perturbation fields generated from a monthly ozone climatology using 1998 to 2006 ozonesonde data from the Southern Hemisphere Additional Ozonesondes (SHADOZ) network and the 13-year satellite record from 1993 to 2005 obtained from the Halogen Occultation Experiment (HALOE). The long time series and high vertical resolution of the ozone and temperature profiles from the SHADOZ sondes coupled with good tropical coverage north and south of the equator gives a detailed picture of the ozone structure in the lowermost stratosphere down through the tropopause where the picture obtained from HALOE measurements is blurred by coarse vertical resolution. Ozone perturbations respond to annual variations in the Brewer-Dobson Circulation (BDC) in the region just above the cold-point tropopause to around 20 km. Annual cycles in ozone and temperature are well correlated. Above 20 km, ozone and temperature perturbations are dominated by the Quasi-biennial Oscillation (QBO). Both satellite and sonde records show good agreement between positive and negative ozone mixing ratio anomalies and alternating QBO westerly and easterly wind shears from the Singapore rawinsondes with a mean periodicity of 26 months for SHADOZ and 25 months for HALOE. There is a temporal offset of one to three months with the QBO wind shear ahead of the ozone anomaly field. The meridional length scales for the annual cycle and the QBO, obtained using the temperature anomalies and wind shears in the thermal wind equation, compare well with theoretical calculations.

Author

*Ozone; Quasi-Biennial Oscillation; Atmospheric Composition; Climatology; Time Series Analysis; Periodic Variations; Perturbation; Wind (Meteorology); Atmospheric Temperature*

**20090035004** NASA Goddard Space Flight Center, Greenbelt, MD, USA

**Understanding Ice Supersaturation, Particle Growth, and Number Concentration in Cirrus Clouds**

Comstock, Jennifer M.; Lin, Ruei-Fong; Starr, David O'C.; Yang, Ping; Journal of Geophysical Research - Atmospheres; Dec. 2008; ISSN 0148-0227; Volume 113; 1 pp.; In English; Copyright; Avail.: Other Sources

ONLINE: <http://dx.doi.org/10.1029/2008JD010332>

Many factors control the ice supersaturation and microphysical properties in cirrus clouds. We explore the effects of dynamic forcing, ice nucleation mechanisms, and ice crystal growth rate on the evolution and distribution of water vapor and cloud properties in nighttime cirrus clouds using a one-dimensional cloud model with bin microphysics and remote sensing measurements obtained at the Department of Energy's Atmospheric Radiation Measurement (ARM) Climate Research Facility located near Lamont, OK. We forced the model using both large-scale vertical ascent and, for the first time, mean mesoscale velocity derived from radar Doppler velocity measurements. Both heterogeneous and homogeneous nucleation processes are explored, where a classical theory heterogeneous scheme is compared with empirical representations. We evaluated model simulations by examining both bulk cloud properties and distributions of measured radar reflectivity, lidar extinction, and water vapor profiles, as well as retrieved cloud microphysical properties. Our results suggest that mesoscale variability is the primary mechanism needed to reproduce observed quantities. Model sensitivity to the ice growth rate is also investigated. The

most realistic simulations as compared with observations are forced using mesoscale waves, include fast ice crystal growth, and initiate ice by either homogeneous or heterogeneous nucleation. Simulated ice crystal number concentrations (tens to hundreds particles per liter) are typically two orders of magnitude smaller than previously published results based on aircraft measurements in cirrus clouds, although higher concentrations are possible in isolated pockets within the nucleation zone.

Author

*Cirrus Clouds; Cloud Physics; Crystal Growth; Ice; Mathematical Models; Remote Sensing; Supersaturation*

**20090035572** Pacific Northwest National Lab., Richland, WA, USA

**Need for a Biotechnology Revolution Focused on Energy and Climate Change**

Dooley, J. J.; Jun. 04, 2001; 15 pp.; In English

Contract(s)/Grant(s): DE-AC05-76RL01830

Report No.(s): DE2009-949180; PNNL-13551; No Copyright; Avail.: National Technical Information Service (NTIS)

This paper utilizes the Pacific Northwest National Laboratory's Integrated Assessment modeling tools to draw out concepts that should be considered when examining purpose-grown biomass as a low-emissions energy source and/or as a key technology for addressing climate change. The paper concludes that using biomass as a significant element of our future energy system will be an enormous undertaking that will transform the global energy and agricultural system. Further, large-scale biomass energy requires substantial advances in the basic science of plant design, an integrated approach to basic and applied research, concurrent consideration of ethical and economic issues, effective planning for market transition, and reliable monitoring systems. Biomass energy is a straightforward concept but a complex endeavor necessitating a coordinated, programmatic effort.

NTIS

*Biomass; Biotechnology; Climate; Climate Change; Fuels*

**20090035574** Forest Service, Missoula, MT USA

**Modeling Surface Winds in Complex Terrain for Wildland Fire Incident Support**

Finney, M.; Bradshaw, L.; Butler, B.; Oct. 2006; 10 pp.; In English

Contract(s)/Grant(s): 03-2-1-04

Report No.(s): PB2009-113801; No Copyright; Avail.: National Technical Information Service (NTIS)

One major source of uncertainty in fire behavior predictions is the spatial variation in winds blowing over mountainous terrain. Fire managers have not had access to real time predictions of surface wind flow. This project combines digital elevation map images with fluid dynamics predictive tools to simulate surface wind speed and direction at the 100m scale on the terrain surface. The project had three objectives: (1) Develop a methodology for producing high resolution surface wind maps; (2) Quantify the effect of high resolution surface wind data on fire behavior predictions; (3) Address the practical potential for modeling fire-induced changes to the wind fields.

NTIS

*Computerized Simulation; Fires; Ground Wind; Terrain; Wind (Meteorology)*

**20090035732** Global Change Research Program, Washington, DC, USA

**Land-Use Scenarios: National Scale Housing Density Scenarios Consistent with Climate Change Storylines**

June 2009; 137 pp.; In English

Report No.(s): PB2009-114036; EPA/600/R-08/76F; No Copyright; Avail.: National Technical Information Service (NTIS)

Climate and land-use change are major components of global environmental change with feedbacks between these components. The consequences of these interactions show that land use may exacerbate or alleviate climate-change effects. Based on these findings it is important to use land-use scenarios that are consistent with the specific assumptions underlying climate-change scenarios. The Integrated Climate and Land-Use Scenarios (ICLUS) project developed land-use outputs that are based on the Intergovernmental Panel on Climate Change (IPCC) Special Report on Emissions Scenarios (SRES) social, economic, and demographic storylines and adapted these to the USA. ICLUS outputs are derived from a pair of models. A demographic model generates population estimates that are distributed by the spatial allocation model as housing density (HD) across the landscape; land-use outputs were developed for the four main SRES storylines and a base case. The model is run for the conterminous USA and output is available for each scenario by decade to 2100. In addition to maps of HD across the conterminous USA, this project also generated maps of impervious surface (IS) cover based on the HD projections.

NTIS

*Climate Change; Land Use; Man Environment Interactions; Environment Effects*

**20090035738** Jet Propulsion Lab., California Inst. of Tech., Pasadena, CA, USA

**Airborne Carbon Dioxide Laser Absorption Spectrometer for IPDA Measurements of Tropospheric CO<sub>2</sub>: Recent Results**

Spiers, Gary D.; Menzies, Robert T.; June 23, 2008; 4 pp.; In English; 24th International Laser Radar Conference, 23 Jun. 2008, Boulder, CO, USA; Original contains black and white illustrations; Copyright; Avail.: Other Sources

ONLINE: <http://hdl.handle.net/2014/41398>

The National Research Council's decadal survey on Earth Science and Applications from Space[1] recommended the Active Sensing of CO<sub>2</sub> Emissions over Nights, Days, and Seasons (ASCENDS) mission for launch in 2013-2016 as a logical follow-on to the Orbiting Carbon Observatory (OCO) which is scheduled for launch in late 2008 [2]. The use of a laser absorption measurement technique provides the required ability to make day and night measurements of CO<sub>2</sub> over all latitudes and seasons. As a demonstrator for an approach to meeting the instrument needs for the ASCENDS mission we have developed the airborne Carbon Dioxide Laser Absorption Spectrometer (CO<sub>2</sub>LAS) which uses the Integrated Path Differential Absorption (IPDA) Spectrometer [3] technique operating in the 2 micron wavelength region.. During 2006 a short engineering checkout flight of the CO<sub>2</sub>LAS was conducted and the results presented previously [4]. Several short flight campaigns were conducted during 2007 and we report results from these campaigns.

Author

*Carbon Dioxide; Absorption Spectroscopy; Troposphere; Periodic Variations; Earth Sciences; Orbiting Carbon Observatory (OCO); Detection; Laser Spectroscopy*

## 51

### LIFE SCIENCES (GENERAL)

Includes general research topics related to plant and animal biology (non-human); ecology; microbiology; and also the origin, development, structure, and maintenance of animals and plants in space and related environmental conditions. For specific topics in life sciences see *categories 52 through 55*.

**20090035745** Battelle National Biodefense Inst., Frederick, MD USA

**Potential for North American Mosquitoes to Transmit Rift Valley Fever Virus**

Turell, Michael J.; Dohm, David J.; Mores, Christopher N.; Terracina, Lucas; Wallette, Dennis L., Jr.; Hribar, Lawrence J.; Pecor, James E.; Blow, Jamie A.; Journal of the American Mosquito Control Association; December 1, 2008; Volume 24, Issue 4, pp. 502-507; In English

Contract(s)/Grant(s): Proj-04-0-DH-009

Report No.(s): AD-A504801; TR-08-044; No Copyright; Avail.: Defense Technical Information Center (DTIC)

ONLINE: <http://hdl.handle.net/100.2/ADA504801>

The rapid spread of West Nile viral activity across North America since its discovery in 1999 illustrates the potential for an exotic arbovirus to be introduced and widely established across North America. Rift Valley fever virus (RVFV) has been responsible for large outbreaks in Africa that have resulted in hundreds of thousands of human infections and major economic disruption. However, little is known about the potential for North American mosquitoes to transmit this virus should it be introduced into North America. Therefore, we evaluated selected mosquito species from the southeastern US for their ability to serve as potential vectors for RVFV. Mosquitoes were fed on adult hamsters inoculated 1 day previously with RVFV. These mosquitoes were tested for infection and ability to transmit RVFV after incubation at 26C for 7-21 days. None of the species tested (*Aedes taeniorhynchus*, *Ae. vexans*, *Culex erraticus*, *Cx. nigripalpus*, *Cx. quinquefasciatus*, and *Cx. salinarius*) were efficient vectors after they fed on hamsters with viremias 106.9 plaque-forming units (PFU)/ml. However, *Ae. taeniorhynchus*, *Ae. vexans*, and *Cx. erraticus* all developed disseminated infections after they fed on hamsters with viremias between 108.5 and 1010.2 PFU/ml, and both *Ae. vexans*, and *Cx. erraticus* transmitted RVFV by bite. These studies illustrate the need to identify the ability of individual mosquito species to transmit RVFV so that correct decisions can be made concerning the application of appropriate control measures during an outbreak.

DTIC

*Africa; Diseases; Fever; Infectious Diseases; Insects; Parasitic Diseases; Viruses*

**20090036313** NASA Ames Research Center, Moffett Field, CA, USA

**Bio-Nanotechnology: Challenges for Trainees in a Multidisciplinary Research Program**

Koehne, Jessica Erin; February 14, 2009; 14 pp.; In English; AAAS National Meeting, 12-14 Feb. 2009, Chicago, IL, USA; Original contains color and black and white illustrations

Contract(s)/Grant(s): NIH 1R21 GM077850-01; NSF CHE-0809977; WBS 736466.09.01.01.03

Report No.(s): ARC-E-DAA-TN443; No Copyright; Avail.: CASI: A03, Hardcopy

ONLINE: <http://hdl.handle.net/2060/20090036313>

The recent developments in the field of nanotechnology have provided scientists with a new set of nanoscale materials, tools and devices in which to investigate the biological science thus creating the multidisciplinary field of bio-nanotechnology. Bio-nanotechnology merges the biological sciences with other scientific disciplines ranging from chemistry to engineering. Today's students must have a working knowledge of a variety of scientific disciplines in order to be successful in this new field of study. This talk will provide insight into the issue of multidisciplinary education from the perspective of a graduate student working in the field of bio-nanotechnology. From the classes we take to the research we perform, how does the modern graduate student attain the training required to succeed in this field?

Author

*Education; Nanotechnology; Biotechnology*

**52**

**AEROSPACE MEDICINE**

Includes the biological and physiological effects of atmospheric and space flight (weightlessness, space radiation, acceleration, and altitude stress) on the human being; and the prevention of adverse effects on those environments. For psychological and behavioral effects of aerospace environments, see *53 Behavioral Sciences*. For the effects of space on animals and plants see *51 Life Sciences*.

**20090034908** Air Force Research Lab., Mesa, AZ USA

**Barriers, Bridges, and Progress in Cognitive Modeling for Military Applications**

Gluck, Kevin; Frontiers of Engineering: Reports on Leading-Edge Engineering from the 2007 Symposium; Jan. 2008, pp. 99-104; In English

Contract(s)/Grant(s): Proj-1123

Report No.(s): AD-A505170; AFRL-RH-AZ-BC-2008-0001; No Copyright; Avail.: Defense Technical Information Center (DTIC)

The role of the Air Force Research Laboratory (AFRL), like the other service laboratories, is to conduct the basic and applied research and advanced technology development necessary to create future technology options for the Department of Defense. At the Warfighter Readiness Research Division of AFRL's Human Effectiveness Directorate, we have initiated a research program focused on mathematical and computational cognitive process modeling for replicating, understanding, and predicting human performance and learning. This research will lead to new technology options in the form of human-level synthetic teammates, cognitive readiness analysis tools, and predictive and prescriptive knowledge-tracing algorithms. Creating a future in which these objectives become realities requires tightly coupled, multidisciplinary, collaborative interaction among scientists and engineers dedicated to overcoming the myriad challenges standing between current reality and our future vision.

DTIC

*Cognition; Learning; Military Technology; Models; Progress; Research and Development*

**20090035723** NASA Johnson Space Center, Houston, TX, USA

**Translational Vestibulo-Ocular Reflexes During Off-Vertical Axis Rotation**

Wood, Scott J.; Clement, Gilles; [2009]; 1 pp.; In English; 33rd Association for Research in Otolaryngology Mid-Winter Meeting, 6-10 Feb. 2010, Anaheim, CA, USA

Report No.(s): JSC-CN-19013; Copyright; Avail.: Other Sources; Abstract Only

The translational vestibulo-ocular reflex (tVOR) is an otolith-mediated response that stabilizes near vision during linear acceleration at higher frequencies where visually mediated reflexes are not adequate. The modulation of horizontal and vergence eye movements during Off-Vertical Axis Rotation (OVAR) are presumed to reflect the tVOR in response to the continuously varying linear acceleration in the interaural and nasooccipital axes, respectively. The purpose of this study was to examine the effect of frequency and fixation distance on the modulation of slow phase eye velocity (SPV) as further evidence that the tVOR is elicited during OVAR. Eighteen subjects were rotated about their longitudinal axis tilted by 30 deg



off-vertical. Rotational velocities varied between 18 and 288 deg/sec corresponding to a frequency range of 0.05 to 0.8 Hz. Fixation distance was altered by asking subjects to imagine stationary targets that were briefly presented at 0.5, 1 and 2 m during some rotation cycles. The target flash was 40 msec in the nose-up position at eye level. Oculomotor responses were recorded in the dark using infrared binocular videography. Sinusoidal curve fits were used to derive amplitude, phase and bias velocity of the eye movements across multiple rotation cycles. Consistent with previous studies, the modulation of both horizontal and vergence SPV increased with stimulus frequency. The effect of fixation distance was negligible at lower frequencies. The modulation of horizontal and vergence SPV was; however, proportional to fixation distance during OVAR at 0.8 Hz. This increasing sensitivity and dependence on fixation distance of horizontal and vergence SPV during OVAR is consistent with tVOR characteristics measured during other types of linear motion. We conclude that the modulation of horizontal and vergence SPV will be diagnostically more useful at higher stimulus frequencies where the tVOR is more robust.

Author

*Eye Movements; Otolith Organs; Video Data; Eye (Anatomy); Frequency Ranges; Reflexes*

**20090035725** NASA Johnson Space Center, Houston, TX, USA

#### **Traditional Cardiovascular Risk Factors as Predictors of Cardiovascular Events in the U.S. Astronaut Corps**

Halm, M. K.; Clark, A.; Wear, M. L.; Murray, J. D.; Polk, J. D.; Amirian, E.; [2009]; 1 pp.; In English; Kelsey Research Foundation's 10th Annual Health Services & Outcomes Research Conference, 2 Dec. 2009, Houston, TX, USA  
Report No.(s): JSC-CN-18979; Copyright; Avail.: Other Sources; Abstract Only

Risk prediction equations from the Framingham Heart Study are commonly used to predict the absolute risk of myocardial infarction (MI) and coronary heart disease (CHD) related death. Predicting CHD-related events in the U.S. astronaut corps presents a monumental challenge, both because astronauts tend to live healthier lifestyles and because of the unique cardiovascular stressors associated with being trained for and participating in space flight. Traditional risk factors may not hold enough predictive power to provide a useful indicator of CHD risk in this unique population. It is important to be able to identify individuals who are at higher risk for CHD-related events so that appropriate preventive care can be provided. This is of special importance when planning long duration missions since the ability to provide advanced cardiac care and perform medical evacuation is limited. The medical regimen of the astronauts follows a strict set of clinical practice guidelines in an effort to ensure the best care. The purpose of this study was to evaluate the utility of the Framingham risk score (FRS), low-density lipoprotein (LDL) and high-density lipoprotein levels, blood pressure, and resting pulse as predictors of CHD-related death and MI in the astronaut corps, using Cox regression. Of these factors, only two, LDL and pulse at selection, were predictive of CHD events (HR(95% CI)=1.12 (1.00-1.25) and HR(95% CI)=1.70 (1.05-2.75) for every 5-unit increase in LDL and pulse, respectively). Since traditional CHD risk factors may lack the specificity to predict such outcomes in astronauts, the development of a new predictive model, using additional measures such as electron-beam computed tomography and carotid intima-media thickness ultrasound, is planned for the future.

Author

*Cardiovascular System; Astronauts; Risk; Blood Pressure; Myocardial Infarction; Medical Services*

**20090035754** Air Force Research Lab., Mesa, AZ USA

#### **Fluctuations in Alertness and Sustained Attention: Predicting Driver Performance**

Gunzelmann, Glenn; Moore, L. Richard, Jr.; Salvucci, Dario D.; Gluck, Kevin A.; Ninth International Conference on Cognitive Modeling; July 2009; 7 pp.; In English; 9th International Conference on Cognitive Modeling (ICCM 2009), 24-26 Jul. 2009, Manchester, UK; Original contains black and white illustrations

Contract(s)/Grant(s): FA8650-05-D-6502; N00014-09-1-0096; AFOSR-07HE01COR; Proj-2313; 61102F

Report No.(s): AD-A504476; AFRL-RH-AZ-PR-2009-0003; No Copyright; Avail.: Defense Technical Information Center (DTIC)

ONLINE: <http://hdl.handle.net/100.2/ADA504476>

Fatigue has been implicated in an alarming number of motor vehicle accidents, costing billions of dollars and thousands of lives. Unfortunately, the ability to predict performance impairments in complex task domains like driving is limited by a gap in our understanding of the explanatory mechanisms. In this paper, we describe an attempt to generate a priori predictions of degradations in driver performance due to sleep deprivation. We accomplish this by integrating an existing account of the effect of sleep loss and circadian rhythms on sustained attention performance with a validated model of driver behavior.

Although quantitative empirical data for validation are lacking, the predicted results across four days of sleep deprivation match qualitative trends published in the literature, and illustrate the potential for making useful predictions of performance in naturalistic task contexts that are relevant to real applied problems.

DTIC

*Alertness; Mathematical Models; Performance Prediction; Sleep Deprivation*

**20090035802** NASA Johnson Space Center, Houston, TX, USA

**The Integrated Medical Model: A Risk Assessment and Decision Support Tool for Space Flight Medical Systems**

Kerstman, Eric; Minard, Charles; Saile, Lynn; deCarvalho, Mary Freire; Myers, Jerry; Walton, Marlei; Butler, Douglas; Iyengar, Sriram; Johnson-Throop, Kathy; Baumann, David; [2009]; 2 pp.; In English; AsMA Annual meeting, 9-13 May 2010, Phoenix, AZ, USA

Report No.(s): JSC-CN-18951; Copyright; Avail.: CASI: [A01](#), Hardcopy

ONLINE: <http://hdl.handle.net/2060/20090035802>

The Integrated Medical Model (IMM) is a decision support tool that is useful to mission planners and medical system designers in assessing risks and designing medical systems for space flight missions. The IMM provides an evidence based approach for optimizing medical resources and minimizing risks within space flight operational constraints. The mathematical relationships among mission and crew profiles, medical condition incidence data, in-flight medical resources, potential crew functional impairments, and clinical end-states are established to determine probable mission outcomes. Stochastic computational methods are used to forecast probability distributions of crew health and medical resource utilization, as well as estimates of medical evacuation and loss of crew life. The IMM has been used in support of the International Space Station (ISS) medical kit redesign, the medical component of the ISS Probabilistic Risk Assessment, and the development of the Constellation Medical Conditions List. The IMM also will be used to refine medical requirements for the Constellation program. The IMM outputs for ISS and Constellation design reference missions will be presented to demonstrate the potential of the IMM in assessing risks, planning missions, and designing medical systems. The implementation of the IMM verification and validation plan will be reviewed. Additional planned capabilities of the IMM, including optimization techniques and the inclusion of a mission timeline, will be discussed. Given the space flight constraints of mass, volume, and crew medical training, the IMM is a valuable risk assessment and decision support tool for medical system design and mission planning.

Author

*Aerospace Medicine; Risk Assessment; Decision Support Systems; International Space Station; Systems Integration; Models*

**20090035805** Universities Space Research Association, Houston, TX, USA

**Defining Nitrogen Kinetics for Air Break in Prebreathe**

Conkin, Johnny; [2009]; 1 pp.; In English; 81st Annual Scientific Meeting of the Aerospace Medical Association, 9-13 May 2010, Phoenix, Az, USA

Report No.(s): JSC-CN-18959; Copyright; Avail.: Other Sources; Abstract Only

Actual tissue nitrogen (N<sub>2</sub>) kinetics are complex; the uptake and elimination is often approximated with a single half-time compartment in statistical descriptions of denitrogenation [prebreathe (PB)] protocols. Air breaks during PB complicate N<sub>2</sub> kinetics. A comparison of symmetrical versus asymmetrical N<sub>2</sub> kinetics was performed using the time to onset of hypobaric decompression sickness (DCS) as a surrogate for actual venous N<sub>2</sub> tension. Published results of 12 tests involving 179 hypobaric exposures in altitude chambers after PB, with and without air breaks, provide the complex protocols from which to model N<sub>2</sub> kinetics. DCS survival time for combined control and air breaks were described with an accelerated log logistic model where N<sub>2</sub> uptake and elimination before, during, and after the air break was computed with a simple exponential function or a function that changed half-time depending on ambient N<sub>2</sub> partial pressure.  $P1N2 - P2 = \Delta P$  defined DCS dose for each altitude exposure, where P<sub>2</sub> was the test altitude and P<sub>1</sub>N<sub>2</sub> was computed N<sub>2</sub> pressure at the beginning of the altitude exposure. The log likelihood (LL) without DCS dose (null model) was -155.6, and improved (best-fit) to -97.2 when dose was defined with a 240 min half-time for both N<sub>2</sub> elimination and uptake during the PB. The description of DCS survival time was less precise with asymmetrical N<sub>2</sub> kinetics, for example, LL was -98.9 with 240 min half-time elimination and 120 min half-time uptake. The statistical regression described survival time mechanistically linked to symmetrical N<sub>2</sub> kinetics during PBs that also included air breaks. The results are data-specific, and additional data may change the conclusion. The regression is useful to compute additional PB time to compensate for an air break in PB within the narrow range of tested conditions.

Author

*Kinetics; Denitrogenation; Decompression Sickness; Hypobaric Atmospheres; Nitrogen; Mathematical Models*

**20090035807** NASA Johnson Space Center, Houston, TX, USA

**Results of a Prospective Echocardiography Trial in International Space Station Crew**

Hamilton, Douglas R.; Sargsyan, Ashot E.; Martin, David; Garcia, Kathleen M.; Melton, Shannon; Feiverson, Alan; Dulchavsky, Scott A.; [2009]; 1 pp.; In English; 81st Annual Scientific Meeting of the Aerospace Medical Association, 9-13 May 2010, Phoenix, AZ, USA

Report No.(s): JSC-CN-19029; Copyright; Avail.: Other Sources; Abstract Only

In the framework of an operationally oriented investigation, we conducted a prospective trial of a standard clinical echocardiography protocol in a cohort of long-duration crewmembers. The resulting primary and processed data appear to have no precedents. Our tele-echocardiography paradigm, including just-in-time e-training methods, was also assessed. A critical review of the imaging technique, equipment and setting limitations, and quality assurance is provided, as well as the analysis of 'space normal' data.

Author

*Education; Echocardiography; Spacecrews; International Space Station*

**20090036285** Air Force Research Lab., Mesa, AZ USA

**Sleep Deprivation and Sustained Attention Performance: Integrating Mathematical and Cognitive Modeling**

Gunzelmann, Glenn; Gross, Joshua B.; Gluck, Kevin A.; Dinges, David F.; Cognitive Science; August 2009; Volume 33, pp. 880-910; In English; Original contains black and white illustrations

Contract(s)/Grant(s): FA8650-05-D-6502; 04HE02COR; 07HE01COR; F49620-95-1-0388; F49620-00-1-0266; RR00040; Proj-2313; 61102F

Report No.(s): AD-A504707; AFRL-RH-AZ-JA-2009-0002; No Copyright; Avail.: Defense Technical Information Center (DTIC)

ONLINE: <http://hdl.handle.net/100.2/ADA504707>

A long history of research has revealed many neurophysiologic changes and concomitant behavioral impacts of sleep deprivation, sleep restriction, and circadian rhythms. Little research, however, has been conducted in the area of computational cognitive modeling to understand the information processing mechanisms through which neurobehavioral factors operate to produce degradations in human performance. Our approach to understanding this relationship is to link predictions of overall cognitive functioning, or alertness, from existing biomathematical models to information processing parameters in a cognitive architecture, leveraging the strengths from each to develop a more comprehensive explanation. The integration of these methodologies is used to account for changes in human performance on a sustained attention task across 88 hrs of total sleep deprivation. The integrated model captures changes due to time awake and circadian rhythms, and also provides an account for underlying changes in the cognitive processes that give rise to those effects. The results show the potential for developing mechanistic accounts of how fatigue impacts cognition, and illustrate the increased explanatory power that is possible by combining theoretical insights from multiple methodologies.

DTIC

*Circadian Rhythms; Cognition; Mathematical Models; Psychomotor Performance; Sleep Deprivation*

**20090036312** NASA Johnson Space Center, Houston, TX, USA

**Acute Hemodynamic Effects of the Braslet-M Device on the International Space Station**

Hamilton, Douglas R.; Barratt, Michael R.; Sargsyan, Ashot E.; Garcia, Kathleen M.; Ebert, Douglas; Martin, David; Dulchavsky, Scott A.; Duncan, J. Michael; [2009]; 1 pp.; In English; Aerospace Medicine Association Annual meeting, 9-13 May 2010, Phoenix, AZ, USA

Report No.(s): JSC-CN-19033; Copyright; Avail.: Other Sources; Abstract Only

The Braslet-M occlusion device is prescribed for cosmonauts as a countermeasure for early phases of spaceflight to temporarily alleviate symptoms associated with the cephalad fluid shift. Using a multipurpose ultrasound (US) device onboard, we assessed the acute hemodynamic effects of the Bracelet-M device on a long duration International Space Station (ISS) crewmember. Methods A combination of just-in-time training and real-time remote expert assistance was used to conduct the imaging procedures. An HDI-5000 imager (Philips, Bothell, WA) was used, provided by the ISS Human Research Facility. Superficial femoral artery (SFA), femoral vein (FV) flow spectra were obtained at mid-thigh level. Left ventricle was imaged through the apical 4-chamber view, with Color M-Mode to measure propagation velocity (V (p)). After 10 minutes of Bracelet-M use, data collection was repeated. All data were transmitted in DICOM format to ground for analysis. Results With Braslet-M, cardiac V(p) slope decreased (56ms to 42ms). A stagnation signature in the FV was seen suggesting impeded flow (rouleaux formation, too-low-to-measure velocity, and increase in diameter). Quadri-phasic flow in SFA was seen both before and after Braslet-M application. Velocities in the SFA decreased with Braslet-M (65cm/sec to 52cm/sec) and so did the time

velocity integrals (16.97 to 12.4); the flow pattern spoke of resistivity increase in the vascular bed. Conclusion In the long duration ISS crewmember we observed effects of lower extremity venous occlusion through both central and peripheral indicators. A part of circulating volume transferred to peripheral potential vascular space. Impediment to venous outflow was demonstrated objectively, with a commensurate change in the flow pattern of the main feeding artery. Central volume reduction caused lower V(p). Additional studies are warranted to determine the time course of the changes and the dynamics in interstitial fluid sequestration, as well as the safe levels and duration of the compression forces.

Author

*Cardiovascular System; Countermeasures; Fluid Shifts (Biology); Hemodynamic Responses; Physiological Effects; Hemodynamics; Blood Circulation; Medical Equipment*

**20090036343** NASA Johnson Space Center, Houston, TX, USA

#### **Toxicity of Lunar Dust in Lungs Assessed by Examining Biomarkers in Exposed Mice**

Lam, C.-W.; James, J. T.; Zeidler-Erdely, P. C.; Castranova, V.; Young, S. H.; Quan, C. L.; Khan-Mayberry, N.; Taylor, L. A.; [2009]; 1 pp.; In English; 49th Annual Meeting and ToxExpo, 7-11 Mar. 2010, Salt Lake City, UT, USA

Report No.(s): JSC-CN-18962; Copyright; Avail.: Other Sources; Abstract Only

NASA plans to build an outpost on the Moon for prolonged human habitation and research. The lunar surface is covered by a layer of soil, of which the finest portion is highly reactive dust. NASA has invited NIOSH to collaboratively investigate the toxicity of lunar dust. Dust samples of respirable sizes were aerodynamically isolated from two lunar soil samples of different maturities (cosmic exposure ages) collected during the Apollo 16 mission. The lunar dust samples, titanium dioxide, or quartz, suspended in normal saline or in Survanta (a bovine lung surfactant), were given to groups of 5 mice (C-57 male) by intrapharyngeal aspiration at 1, 0.3, or 0.1 mg/mouse. The mice were euthanized 7 or 30 days later, and their lungs were lavaged to assess the toxicity biomarkers in bronchioalveolar lavage fluids. The acellular fractions were assayed for total proteins, lactate dehydrogenase activities, and cytokines; the cellular portions were assessed for total cell counts and cell differentials. Results from the high-dose groups showed that lunar dust, suspended in saline, was more toxic than TiO<sub>2</sub>, but less toxic than quartz. Lunar dust particles aggregate and settle out rapidly in water or saline, but not in Survanta. Lunar dust suspended in Survanta manifested greater toxicity than lunar dust in saline. The increase in toxicity presumably was due to that Survanta gave a better particle dispersion in the lungs. The two lunar dust samples showed similar toxicity. The overall results showed that lunar dust is more toxic than TiO<sub>2</sub> but less toxic than quartz.

Author

*Lunar Dust; Toxicity; Lungs; Mice; Reactivity; Biomarkers; Exposure; Quartz*

## **54**

### **MAN/SYSTEM TECHNOLOGY AND LIFE SUPPORT**

Includes human factors engineering, bionics, man-machine systems, life support, space suits and protective clothing. For related information see also *16 Space Transportation and Safety* and *52 Aerospace Medicine*.

**20090035633** National Science and Technology Council, Washington, DC USA

#### **Biometrics Foundation Documents**

Blackburn, Duane; Miles, Chris; Wing, Brad; Jan 2009; 168 pp.; In English

Report No.(s): AD-A505048; No Copyright; Avail.: Defense Technical Information Center (DTIC)

This set of Frequently Asked Questions (FAQs) was developed by the National Science & Technology Council's (NSTC) Subcommittee on Biometrics with the full understanding that national (INCITS/M1) and international (ISO/IEC JTC1 SC37) standards bodies are working to develop standard references. The subcommittee will review this set of FAQs for consistency as standards are passed. The subcommittee recognizes the impact of ongoing challenge problems, technical evaluations, and technology advancements. The FAQs will be updated accordingly to reflect these changes. The statements herein are intended to further the understanding of a general audience and are not intended to replace or compete with sources that may be more technically descriptive/prescriptive.

DTIC

*Biometrics; Consistency*



**20090036315** NASA Ames Research Center, Moffett Field, CA, USA

**The Concept and Experimental Investigation of CO<sub>2</sub> and Steam Co-electrolysis for Resource Utilization in Space Exploration**

Stoots, Carl; Mulloth, Lila M.; Luna, Bernadette; Varghese, Mini M.; July 12, 2009; In English; International Conference On Environmental Systems, 12-16 Jul. 2009, Savannah, GA, USA

Contract(s)/Grant(s): WBS 439906.04.01.01

Report No.(s): ARC-E-DAA-TN408; Copyright; Avail.: Other Sources; Abstract Only

CO<sub>2</sub> acquisition and utilization technologies will have a vital role in determining sustained and affordable life support and in-situ fuel production architectures for human and robotic exploration of Moon and Mars. For long-term human exploration to be practical, reliable technologies have to be implemented to capture and chemically reduce the metabolic CO<sub>2</sub> from the cabin air to reconstitute oxygen consumption. Technologies that facilitate the in-situ capture and conversion of atmospheric CO<sub>2</sub> to fuel are essential for a viable human mission to Mars and their demonstration on the moon is critical as well. This paper describes the concept and experimental investigation of a CO<sub>2</sub> capture and reduction system that comprises an adsorption compressor and a CO<sub>2</sub> and steam co-electrolysis unit. The process products include oxygen for life support and Syngas (CO and H<sub>2</sub>) for synthetic fuel production. Electrochemical performance in terms of CO<sub>2</sub> conversion, oxygen production, and power consumption of a system with a capacity to process 1kg CO<sub>2</sub> per day (1-person equivalent) will be discussed.

Author

*Carbon Dioxide; Electrolysis; Life Support Systems; In Situ Resource Utilization*

**20090036320** NASA Ames Research Center, Moffett Field, CA, USA

**Starship Life Support**

Jones, Harry W.; July 12, 2009; In English; International Conference On Environmental Systems, 12-16 Jul. 2009, Savannah, GA, USA

Contract(s)/Grant(s): WBS 439906.02.01

Report No.(s): ARC-E-DAA-TN506; No Copyright; Avail.: Other Sources; Abstract Only

The design and mass cost of a starship and its life support system are investigated. The mission plan for a multi generational interstellar voyage to colonize a new planet is used to describe the starship design, including the crew habitat, accommodations, and life support. Only current technology is assumed. Highly reliable life support systems can be provided with reasonably small additional mass, suggesting that they can support long duration missions. Bioregenerative life support, growing crop plants that provide food, water, and oxygen, has been thought to need less mass than providing stored food for long duration missions. The large initial mass of hydroponics systems is paid for over time by saving the mass of stored food. However, the yearly logistics mass required to support a bioregenerative system exceeds the mass of food solids it produces, so that supplying stored dehydrated food always requires less mass than bioregenerative food production. A mixed system that grows about half the food and supplies the other half dehydrated has advantages that allow it to breakeven with stored dehydrated food in about 66 years. However, moderate increases in the hydroponics system mass to achieve high reliability, such as adding spares that double the system mass and replacing the initial system every 100 years, increase the mass cost of bioregenerative life support. In this case, the high reliability half food growing, half food supplying system does not breakeven for 389 years. An even higher reliability half and half system, with three times original system mass and replacing the system every 50 years, never breaks even. Growing food for starship life support requires more mass than providing dehydrated food, even for multigeneration voyages of hundreds of years. The benefits of growing some food may justify the added mass cost. Much more efficient recycling food production is wanted but may not be possible. A single multigenerational interstellar voyage to colonize a new planet would have cost similar to that of the Apollo program. Cost is reduced if a small crew travels slowly and lands with minimal equipment. We can go to the stars!

Author

*Design to Cost; Life Support Systems; Habitability; Spacecraft Cabins; Spacecrews; Logistics*

**20090036322** NASA Ames Research Center, Moffett Field, CA, USA

**Implementations of Sensor Webs Utilizing Uninhabited Aerial Systems**

Sullivan, Donald V.; May 04, 2009; 1 pp.; In English; 33rd International Symposium on Remote Sensing of Environment, 4-8 May 2009, Stresa, Italy

Contract(s)/Grant(s): WBS 769134.01.01.02

Report No.(s): ARC-E-DAA-TN423; No Copyright; Avail.: Other Sources; Abstract Only

In this paper we describe the web services, processes, communication protocols and ad-hoc service chains utilized in the



late summer and early fall 2007 Ikhana UAS response to the wildfires burning in southern California. Additionally, we describe the lessons learned that will be applied to the upcoming Global Hawk UAS Aura Satellite Validation Experiment planned for early 2009.

Author

*Web Services; Pilotless Aircraft; Communication Networks; Protocol (Computers); Combustion*

**20090036323** NASA Ames Research Center, Moffett Field, CA, USA

**Developing Ultra Reliable Life Support for the Moon and Mars**

Jones, Harry W.; July 12, 2009; In English; International Conference on Environmental Systems, 12-16 Jul. 2009, Savannah, GA, USA

Contract(s)/Grant(s): WBS 439906.02.01

Report No.(s): ARC-E-DAA-TN509; No Copyright; Avail.: Other Sources; Abstract Only

Recycling life support systems can achieve ultra reliability by using spares to replace failed components. The added mass for spares is approximately equal to the original system mass, provided the original system reliability is not very low. Acceptable reliability can be achieved for the space shuttle and space station by preventive maintenance and by replacing failed units. However, this maintenance and repair depends on a logistics supply chain that provides the needed spares. The Mars mission must take all the needed spares at launch. The Mars mission also must achieve ultra reliability, a very low failure rate per hour, since it requires years rather than weeks and cannot be cut short if a failure occurs. Also, the Mars mission has a much higher mass launch cost per kilogram than shuttle or station. Achieving ultra reliable space life support with acceptable mass will require a well-planned and extensive development effort. Analysis must define the reliability requirement and allocate it to subsystems and components. Technologies, components, and materials must be designed and selected for high reliability. Extensive testing is needed to ascertain very low failure rates. Systems design should segregate the failure causes in the smallest, most easily replaceable parts. The systems must be designed, produced, integrated, and tested without impairing system reliability. Maintenance and failed unit replacement should not introduce any additional probability of failure. The overall system must be tested sufficiently to identify any design errors. A program to develop ultra reliable space life support systems with acceptable mass must start soon if it is to produce timely results for the moon and Mars.

Author

*Recycling; Life Support Systems; Reliability; Preventive Maintenance; Aerospace Systems; Logistics; Systems Engineering; Space Shuttles; Space Stations; Replacing*

**20090036324** NASA Ames Research Center, Moffett Field, CA, USA

**Lunar Base Life Support Failures**

Jones, Harry W.; July 12, 2009; In English; International Conference On Environmental Systems, 12-16 Jul. 2009, Savannah, GA, USA

Contract(s)/Grant(s): WBS 439906.02.01

Report No.(s): ARC-E-DAA-TN508; No Copyright; Avail.: Other Sources; Abstract Only

Dynamic simulation of the lunar outpost habitat life support was undertaken to investigate the impact of life support failures and to investigate responses. Some preparatory static analysis for the Lunar Outpost life support model, an earlier version of the model, and an investigation into the impact of Extravehicular Activity (EVA) were reported previously. (Jones, 2008-01-2184, 2008-01-2017) The earlier model was modified to include possible resupply delays, power failures, recycling system failures, and atmosphere and other material storage failures. Most failures impact the lunar outpost water balance and can be mitigated by reducing water usage. Food solids, nitrogen can be obtained only by resupply from Earth. The most time urgent failure is a loss of carbon dioxide removal capability. Life support failures might be survivable if effective operational solutions are provided in the system design.

Author

*Life Support Systems; Lunar Bases; Extravehicular Activity; System Failures; Recycling; Carbon Dioxide Removal; Water Balance; Habitats*

## MATHEMATICAL AND COMPUTER SCIENCES (GENERAL)

Includes general topics and overviews related to mathematics and computer science. For specific topics in these areas see *categories 60 through 67*.

**20090034899** Northwestern Univ., Evanston, IL, USA; Department of Transportation, Washington, DC, USA

### **Maintenance of NDE Websites**

Dowding, C.; Jan. 2009; 11 pp.; In English

Report No.(s): PB2009-113980; No Copyright; Avail.: National Technical Information Service (NTIS)

This project will maintain one operational Time Domain Reflectometry (TDR) field station and the associated web site. Maintenance of such a site supports three principal activities of ITI: (1) adoption by State DOT's of the the TDR technology, (2) display of ITI's national span of activity, and (3) proof that it employs technology developed by the incubated spin-off, Civil Data Systems. So far sites have been demonstrated in Ohio, California, Indiana, Illinois, Florida, & Pennsylvania. Other states have begun to investigate TDR and would benefit from the information and operational nature of a 'live' site. It is important for ITI to continue to project its successes through its web site, and a 'live' site would provide attraction. Finally, this next year ITI is incubating Civil Data Systems, whose marketing requires proof of adoption. A sinkhole site in Florida was selected as the one site for continued monitoring as it employs a combination of tiltmeters, along with water level and shear deformation TDR cables. Successful monitoring of mine-induced subsidence of I 70 with TDR-Tiltmeter technology for Pennsylvania DOT has lead to use of this combination of TDR instruments for surveillance of sinkhole subsidence of SR 66 and US 27 in Florida this last year. In addition CALTRANS has adopted the combination of tiltmeters and TDR cables for scour monitoring. Thus this site in Florida optimizes the display of ITI technology with one site.

NTIS

*Crack Propagation; Maintenance; Nondestructive Tests; Websites*

**20090034903** Army Command and General Staff Coll., Fort Leavenworth, KS USA

### **Understanding the Form, Function, and Logic of Clandestine Cellular Networks: The First Step in Effective Counternetwork Operations**

Jones, Derek; Apr 2009; 118 pp.; In English; Original contains color illustrations

Report No.(s): AD-A505161; No Copyright; Avail.: Defense Technical Information Center (DTIC)

Since the events of September 11, 2001, U.S. military counternetwork operations, theory, and doctrine have failed to account for the form, function, and logic of clandestine cellular networks used by interstate insurgencies, such as those in Iraq and Afghanistan, and global insurgencies, like al Qaeda and its associated movements. The failure to understand the form, function, and logic of clandestine cellular networks has led to the incorrect application of counternetwork theories. Counternetwork operations specifically targeting key leaders, facilitators, individuals with special skills, or highly connected individuals, intuitively seem to be the correct targets for disconnecting clandestine cellular networks. However, little comparative analysis has been done to verify if these operations are having the effect required to disrupt, neutralize, defeat, or ultimately destroy these networks. A true understanding of cellular networks reveals that the removal of single individuals, regardless of function, is well within the tolerance of this type of organizational structure and has little long-term effect. At the same time, highly connected nodes violate the principles of clandestine operations since they are highly visible when compared to a competent clandestine practitioner who does not want a discernable signature. Thus, by focusing on highly connected individuals as high priority targets, U.S. efforts have effectively culled the herd of poor clandestine practitioners, while further educating the competent clandestine practitioners on U.S. counternetwork methods. This monograph uses a modified process-trace methodology to analyze the form, function, and logic of clandestine cellular networks to dispel the myths associated with current network and counternetwork theories, and challenge contemporary thoughts on counternetwork operations.

DTIC

*Countermeasures; Mathematical Logic; Military Operations; Networks; Targets; Terrorism*

**20090034907** Spy Pond Partners, LLC, Arlington, MA, USA; ERS Association, Somerville, MA, USA

**Tools to Aid State DOTs in Responding to Workforce Challenges**

Martin, B.; January 2009; 91 pp.; In English

Report No.(s): PB2009-113659; NCHRP-636; No Copyright; Avail.: CASI: [A05](#), Hardcopy

State Departments of Transportation (DOTs) face a number of workforce-related challenges that significantly impact their ability to deliver services in an efficient and effective manner. As experienced employees retire and resources tighten, DOTs need to become more strategic about workforce planning and pursue new approaches to recruitment, succession planning, training, and organizational restructuring. Several NCHRP projects have been conducted over the past few years on topics related to workforce management at DOTs, and there is a wealth of other relevant information resources available: case studies, methodologies, guides, software applications that agencies can draw upon. These existing resources can help DOTs understand how their peers are addressing similar issues, discover successful practices, and provide models that may be adapted for a fraction of the cost of what would have been required to design and develop a new program or initiative. However, DOTs are not necessarily aware of what resources exist and may not be able to easily identify information resources that would be helpful to them. The objective of NCHRP Project 20-72 is to articulate key current and emerging DOT workforce needs and link these needs to available resources. In the initial phase of the project, the research team reviewed and assessed current literature, web sites, and practices to identify resources of relevance and value in addressing DOT workforce challenges and developed an organizing framework for the information. In the final phase, a prototype web site was developed that provides access to relevant information resources.

NTIS

*Personnel; Retirement; Transportation; Education; Information Management*

**20090035692** National Security Agency, Fort Meade, MD, USA

**Integrating Flexible Support for Security Policies into the Linux Operating System**

Loscocco, P.; Smalley, S.; Feb. 2001; 62 pp.; In English

Report No.(s): PB2009-114066; No Copyright; Avail.: CASI: [A04](#), Hardcopy

The protection mechanisms of current mainstream operating systems are inadequate to support confidentiality and integrity requirements for end systems. To address this problem, the National Security Agency (NSA) worked with Secure Computing Corporation (SCC) to develop a strong, flexible mandatory access control architecture based on Type Enforcement. This architecture is called Flask. This paper presents the design and implementation for integrating the security mechanisms of the Flask architecture into the Linux kernel.

NTIS

*Policies; Security; Unix (Operating System)*

**20090036329** NASA Ames Research Center, Moffett Field, CA, USA

**A Better Conversion of LTL Formulas to Symbolic Automata**

Rozier, Kristin Y.; Vardi, Moshe Y.; June 26, 2009; 16 pp.; In English; Computer Aided Verification (CAV 2009), 26 Jun. - 2 Jul. 2009, Grenoble, France; Original contains color and black and white illustrations

Contract(s)/Grant(s): NSF EIA-0216467; WBS 411931.02.51.01.10

Report No.(s): ARC-E-DAA-TN409; Copyright; Avail.: CASI: [A03](#), Hardcopy

ONLINE: <http://hdl.handle.net/2060/20090036329>

Symbolic model checking has demonstrated more scalability and reliability than explicit model checking, and is used frequently for industrial verification. Yet, the issue of efficient construction of symbolic automata for LTL formulas has been largely neglected, while explicit translation of LTL to automata has been studied extensively. We show that algorithmic ideas from explicit-state LTL-to-automata translators, as well as translations for other logics, are applicable to the symbolic domain. We propose a new algorithmic-portfolio approach for improved translation from LTL to symbolic automata. We provide experimental results comparing our implementation with the front-end translators built into CadenceSMV and NuSMV and demonstrate that we can consistently achieve better performance, even with a very simple heuristic for choosing a symbolic encoding.

Author

*Automata Theory; Algorithms; Coding; Heuristic Methods*

## COMPUTER PROGRAMMING AND SOFTWARE

Includes software engineering, computer programs, routines, algorithms, and specific applications, e.g., CAD/CAM. For computer software applied to specific applications, see also the associated category.

**20090035634** Pennsylvania Univ., Philadelphia, PA USA

### **Virtual Coaching Agent for Team Training**

Badler, Norman I; Stocker, Catherine; Sunshine-Hill, Ben; Mar 2009; 58 pp.; In English

Contract(s)/Grant(s): FA8650-04-D-6546; Proj-7184

Report No.(s): AD-A505060; No Copyright; Avail.: Defense Technical Information Center (DTIC)

This effort focused on investigating the design and evaluation of an interactive software model to support technical training, as well as for use as an on-the-job task aide. The overarching goals of this research project were to: 1) Utilize motion capture technology to capture the instructional experience of a course instructor for use in the development of a virtual training environment; 2) Provide a mechanism for storing, archiving and efficiently accessing course materials, simulations, Technical Orders (T.O.), multimedia materials, and instructional expertise; 3) Utilize human model avatars as coaches, communicators (instructor surrogates), or simulated maintainers to instruct and illustrate correct and incorrect procedures and practices - especially cautions and warnings; 4) Demonstrate and evaluate a software-based, team training environment for 24/7 instructional access, task preparation, individual practice, and team coordination as an adjunct to hardware trainers and hands-on experience.

DTIC

*Education; Virtual Reality*

**20090035748** Stanford Univ., Stanford, CA USA

### **The Open Source Hardening Project**

Engler, Dawson; Dill, David; July 2009; 60 pp.; In English; Original contains color illustrations

Contract(s)/Grant(s): FA8750-05-2-0142; CCF-0424422; CNS-0238570-001; Proj-DHSD

Report No.(s): AD-A504935; No Copyright; Avail.: Defense Technical Information Center (DTIC)

ONLINE: <http://hdl.handle.net/100.2/ADA504935>

This effort has developed and deployed a broad range of tools for finding serious errors in code. They are designed to find large numbers of errors in large source bases quickly, and with few false reports. We validated these tools by suing them to find bugs in important open-source projects (e.g., Linux, BSD, and many other widely-used projects). As a crucial part of doing so, we built and roan an ongoing open source hardening project that automatically applied our tools to these projects as a nightly regression and published the bugs in a developer-available database of errors. The benefits of automated, regular regressions are fourfold. First, it gave an objective, highly-visible validation that our tools work well on real code. Second, it provided corrective guidance to development, forcing tools to focus on what matters. Third, it strengthened on our relationships with developers on these projects, leading to (among other things) valuable user feedback, checking ideas, and (from experience) customer leads. Finally, and in some ways most important, it led to immediate improvements in the vast open-source infrastructure that serves as a foundation to much of the Nation's computing environments.

DTIC

*Coding; Errors; Open Project*

**20090035760** Engineer Research and Development Center, Vicksburg, MS USA

### **ERDC MSRC (Major Shared Resource Center) Resource, Spring 2008**

[2008]; 33 pp.; In English; Original contains color illustrations

Report No.(s): AD-A504567; No Copyright; Avail.: Defense Technical Information Center (DTIC)

ONLINE: <http://hdl.handle.net/100.2/ADA504567>

ARTICLES: Computational Stream Habitat and Flow Modeling By Dr. Jeffrey B. Allen, Dr. David Smith, Dr. Owen Eslinger, Miguel Valenciano, Dr. John Nestler, and Dr. Andrew R. Goodwin; A Coupled Watershed-Nearshore Model Using the ESMF and DBuilder By Bobby Hunter, Dr. Ruth Cheng, and Dr. Pearce Cheng; Increase Multicore Code Performance with Loop Blocking By Tyler Simon; Mr. Force Protection Himself Named New ERDC Information Technology Laboratory

Director By Rose J. Dykes; Communicate with Your Data By Dr. Michael Stephens; ERDC MSRC and HPCMP Announce Release of ezHPC v.2.0 By Scotty Swillie; ERDC MSRC Puts Expertise on Display at SC07 By Rose J. Dykes; and John West Selected Mississippi State University Distinguished Fellow By Rose J. Dykes.

DTIC

*Computational Fluid Dynamics; Software Development Tools*

**20090035868** NASA Ames Research Center, Moffett Field, CA, USA

**NASA's OCA Mirroring System: An Application of Multiagent Systems in Mission Control**

Sierhuis, Maarten; Clancey, William J.; vanHoof, Ron J. J.; Seah, Chin H.; Scott, Michael S.; Nado, Robert A.; Blumenberg, Susan F.; Shafto, Michael G.; Anderson, Brian L.; Bruins, Anthony C.; Buckley, Chris B.; Diegelman, Thomas E.; Hall, Timothy A.; Hood, Deborah; Reynolds, Fisher F.; Toschlog, Jason R.; Tucker, Tyson; May 10, 2009; 8 pp.; In English; AAMAS 2009 Conference, 10-15 May 2009, Budapest, Hungary; Original contains color illustrations

Report No.(s): ARC-E-DAA-TN433; Copyright; Avail.: Other Sources

Orbital Communications Adaptor (OCA) Flight Controllers, in NASA's International Space Station Mission Control Center, use different computer systems to uplink, downlink, mirror, archive, and deliver files to and from the International Space Station (ISS) in real time. The OCA Mirroring System (OCAMS) is a multiagent software system (MAS) that is operational in NASA's Mission Control Center. This paper presents OCAMS and its workings in an operational setting where flight controllers rely on the system 24x7. We also discuss the return on investment, based on a simulation baseline, six months of 24x7 operations at NASA Johnson Space Center in Houston, Texas, and a projection of future capabilities. This paper ends with a discussion of the value of MAS and future planned functionality and capabilities.

Author

*Downlinking; Flight Control; Computers; Real Time Operation; Uplinking*

## 62

### COMPUTER SYSTEMS

Includes computer networks and distributed processing systems. For information systems see *82 Documentation and Information Science*. For computer systems applied to specific applications, see the associated category.

**20090035747** Air Force Inst. of Tech., Wright-Patterson AFB, OH USA

**Design Considerations for a Cyber Incident Mission Impact Assessment (CIMIA) Process**

Grimaila, Michael R.; Fortson, Larry W.; Sutton, Janet L.; July 13, 2009; 7 pp.; In English; International Conference on Security and Management (SAM09), 13-16 Jul. 2009, Las Vegas, NV, USA

Contract(s)/Grant(s): MIRP-F4FBBA9067J001; F4FBBA9067J001; Proj-AFIT-2009-ENV-2979

Report No.(s): AD-A504934; AFIT/CCR-081025; No Copyright; Avail.: Defense Technical Information Center (DTIC)

ONLINE: <http://hdl.handle.net/100.2/ADA504934>

Virtually all modern organizations have embedded information systems and networking technologies into their core business processes as a means to increase operational efficiency, improve decision making quality, reduce delays, and/or maximize profit. Unfortunately, this dependence can place the organization's mission at risk when the loss or degradation of the confidentiality, integrity, availability, non-repudiation, or authenticity of a critical information resource or flow occurs. In this paper, we motivate design considerations for an information asset-based, Cyber Incident Mission Impact Assessment (CIMIA) process whose goal is to provide decision makers with timely notification and relevant impact assessment, in terms of mission objectives, from the time an information incident is declared, until the incident is fully remediated.

DTIC

*Damage Assessment; Impact; Situational Awareness*

**20090035759** Single Integrated Air Picture System Engineering Task Force, Arlington, VA USA

**System of Systems Technology Readiness Assessment**

Majumdar, Windy J.; September 12, 2007; 30 pp.; In English; 2007 Technology Maturity Conference (TMC), 11-13 Sep. 2009, Virginia Beach, VA, USA; Original contains color illustrations

Report No.(s): AD-A504566; No Copyright; Avail.: Defense Technical Information Center (DTIC)

ONLINE: <http://hdl.handle.net/100.2/ADA504566>

Looks at the challenges of moving from a individual system centered environment to a network centered environment. The



forces, units, and systems of all Services must operate together effectively. Interoperability should be achieved primarily by a commonality of equipment, software, and systems both horizontally and vertically.

DTIC

*Chutes; Interoperability; Systems Engineering; Technology Assessment*

**20090035797** Jet Propulsion Lab., California Inst. of Tech., Pasadena, CA, USA

**Automated Generation and Assessment of Autonomous Systems Test Cases**

Bartrop, Kevin J.; Friberg, Kenneth H.; Horvath, Gregory A.; March 3, 2008; 14 pp.; In English; IEEE Aerospace Conference, 1-8 Mar. 2008, Big Sky, MT, USA; Original contains color and black and white illustrations; Copyright;

Avail.: Other Sources

ONLINE: <http://hdl.handle.net/2014/41387>

This slide presentation reviews some of the issues concerning verification and validation testing of autonomous spacecraft routinely culminates in the exploration of anomalous or faulted mission-like scenarios using the work involved during the Dawn mission's tests as examples. Prioritizing which scenarios to develop usually comes down to focusing on the most vulnerable areas and ensuring the best return on investment of test time. Rules-of-thumb strategies often come into play, such as injecting applicable anomalies prior to, during, and after system state changes; or, creating cases that ensure good safety-net algorithm coverage. Although experience and judgment in test selection can lead to high levels of confidence about the majority of a system's autonomy, it's likely that important test cases are overlooked. One method to fill in potential test coverage gaps is to automatically generate and execute test cases using algorithms that ensure desirable properties about the coverage. For example, generate cases for all possible fault monitors, and across all state change boundaries. Of course, the scope of coverage is determined by the test environment capabilities, where a faster-than-real-time, high-fidelity, software-only simulation would allow the broadest coverage. Even real-time systems that can be replicated and run in parallel, and that have reliable set-up and operations features provide an excellent resource for automated testing. Making detailed predictions for the outcome of such tests can be difficult, and when algorithmic means are employed to produce hundreds or even thousands of cases, generating predicts individually is impractical, and generating predicts with tools requires executable models of the design and environment that themselves require a complete test program. Therefore, evaluating the results of large number of mission scenario tests poses special challenges. A good approach to address this problem is to automatically score the results based on a range of metrics. Although the specific means of scoring depends highly on the application, the use of formal scoring - metrics has high value in identifying and prioritizing anomalies, and in presenting an overall picture of the state of the test program. In this paper we present a case study based on automatic generation and assessment of faulted test runs for the Dawn mission, and discuss its role in optimizing the allocation of resources for completing the test program.

Author

*Autonomy; Systems Engineering; Control Systems Design; Software Engineering; Fault Detection; Proving; Program Verification (Computers)*

**63**

**CYBERNETICS, ARTIFICIAL INTELLIGENCE AND ROBOTICS**

Includes feedback and control theory, information theory, machine learning, and expert systems. For related information see also *54 Man/System Technology and Life Support*.

**20090034906** Army Tank-Automotive Research and Development Command, Warren, MI USA

**Intelligent Ground Systems**

Thomas, David; Apr 15, 2008; 11 pp.; In English; Original contains color illustrations

Report No.(s): AD-A505288; No Copyright; Avail.: Defense Technical Information Center (DTIC)

The mission of TARDEC Robotics is to integrate, explore, and develop robotics, network and control components with a focus on customer driven requirements to provide full system solutions to the war fighter.

DTIC

*Robots; Robotics*

**20090034911** Army Research Development and Engineering Command, Warren, MI USA; Army Research Lab., USA; DCS Corp., USA; Alion Science and Technology, USA

**Robotics Collaboration Army Technology Objective Capstone Soldier Experiment: Unmanned System Mobility**

Alban, Jillyn; Cosenzo, Keryl; Johnson, Tony; Hutchins, Shaun; Metcalfe, Jason; Capstick, Erin; Jul 23, 2009; 21 pp.; In English; AUVSI Conference on Unmanned Systems North America, 10-13 Aug. 2009, Washington, DC, USA; Original contains color illustrations

Report No.(s): AD-A505226; RDECOM/TARDEC-20047RC; No Copyright; Avail.: Defense Technical Information Center (DTIC)

The RC ATO (2004-2008), a joint program between the U.S. Army Tank Automotive Research, Development and Engineering Center (TARDEC) and the Army Research Laboratory (ARL), has the mission of developing the appropriate tools, techniques and autonomy to maximize mounted and dismounted control of ground unmanned systems and optimize Soldier-robot and robot-robot teams. This was accomplished through the development and testing of assisted autonomy and situational awareness solutions, optimizing Soldier-machine interface usability across varying display sizes, control devices and dissimilar robotic systems and the deployment of unique multi-modal control techniques. The ATO concluded its Capstone Experiment and demonstration in September 2008. This paper will detail the technology developed and utilized under the program as well as highlight Capstone Experiment results.

DTIC

*Military Personnel; Mobility; Robotics*

**20090034921** Army Research Development and Engineering Command, Warren, MI USA

**Joint Center for Robotics (JCR)**

Overholt, Jim; Apr 15, 2008; 7 pp.; In English; Original contains color illustrations

Report No.(s): AD-A505270; No Copyright; Avail.: Defense Technical Information Center (DTIC)

TARDEC JCR ROBOTICS: White Hat Organization -- Understand the needs of the user and create partnerships with Academia, Industry and OGA. Intelligent Ground Systems.

DTIC

*Autonomous Navigation; Robotics*

## 64

### NUMERICAL ANALYSIS

Includes iteration, differential and difference equations, and numerical approximation.

**20090034919** National Inst. of Standards and Technology, Boulder, CO USA

**A New Time Scale Algorithm: AT1 Plus Frequency Variance**

Weiss, M; Weissert, T; Nov 1989; 16 pp.; In English

Report No.(s): AD-A505268; No Copyright; Avail.: Defense Technical Information Center (DTIC)

The algorithm which generates the AT1 time scale at the National Institute of Standards and Technology (NIST) has generated a scale with many desirable properties since 1968. Five of these are as follows: 1. The fractional frequency variation of the scale is smaller than any clock in the scale for all integration times. 2. The algorithm adaptively estimates the weights of clocks in real time. 3. The scale is much more reliable than any individual clock. 4. One can add or remove clocks from the scale easily, with a minimum impact on the scale. 5. One can correct the ensemble for calibrations against a primary reference. There are three other properties we would like to obtain: 1. Automatic frequency step detection. 2. A scale optimized for post-processing, including running both forwards and backwards in time. 3. A scale that can run with minimal supervision for use in non-technical environments. It turns out that simply estimating a variance of the frequency state of the clocks facilitates all three of these new properties. We report here a new algorithm which uses techniques from Kalman filtering to estimate this variance. Results from simulation and applications to real clocks are presented also.

DTIC

*Algorithms; Clocks; Frequencies*

**20090035757** Air Force Research Lab., Rome, NY USA; City Univ. of New York, NY, USA

**Adaptive Voting Algorithms for the Reliable Dissemination of Data in Fault-Prone Distributed Environments**

Ravindran, Kaliappa; Kwiat, Kevin A.; Hurley, Patrick; International Journal of Business Intelligence and Data Mining; [2008]; Volume 3, No. 3, pp. 277-304; In English; Original contains color illustrations

Contract(s)/Grant(s): Proj-4519; 62702F

Report No.(s): AD-A504525; AFRL-RI-RS-TP-2009-16; No Copyright; Avail.: Defense Technical Information Center (DTIC)

ONLINE: <http://hdl.handle.net/100.2/ADA504525>

Data collection in a distributed embedded system requires dealing with failures: data corruptions by malicious devices and arbitrary message delay/loss in the network. Replication of data collection devices deals with such failures by voting among the replica devices to move a correct data to the end-user. Here, a data voted upon can be large-sized and/or take a long time to be compiled. The goal of this paper is to engineer the voting protocols for good performance while meeting the reliability requirements of data delivery in a high assurance setting. Two metrics quantify the effectiveness of voting protocols: Data Transfer Efficiency (DTE) and Time-to-Complete (TTC) data delivery. DTE captures the network bandwidth wasted and/or the energy drain in wireless-connected devices; whereas, TTC captures the degradation in user-level Quality of Service (QoS) due to delayed/missed data deliveries. Given the distributed nature of voting, the protocol-level optimizations to improve DTE and TTC reduce the movement of user-level data over the network, the number of control messages generated, and the latency in effecting a data delivery. The paper describes these optimizations, and reports experimental results from a prototype voting system.

DTIC

*Adaptation; Algorithms; Data Acquisition; Data Processing; Information Retrieval; Voting*

**20090035870** NASA Ames Research Center, Moffett Field, CA, USA

**Highly Scalable Matching Pursuit Signal Decomposition Algorithm**

Christensen, Daniel; Das, Santanu; Srivastava, Ashok N.; September 9, 2009; 11 pp.; In English; International Workshop on Structural Health Monitoring, 9-11 Sep. 2009, Stanford, CA, USA; Original contains color and black and white illustrations

Contract(s)/Grant(s): NAS2-03144

Report No.(s): ARC-E-DAA-TN462; Copyright; Avail.: CASI: A03, Hardcopy

ONLINE: <http://hdl.handle.net/2060/20090035870>

Matching Pursuit Decomposition (MPD) is a powerful iterative algorithm for signal decomposition and feature extraction. MPD decomposes any signal into linear combinations of its dictionary elements or atoms. A best fit atom from an arbitrarily defined dictionary is determined through cross-correlation. The selected atom is subtracted from the signal and this procedure is repeated on the residual in the subsequent iterations until a stopping criterion is met. The reconstructed signal reveals the waveform structure of the original signal. However, a sufficiently large dictionary is required for an accurate reconstruction; this in return increases the computational burden of the algorithm, thus limiting its applicability and level of adoption. The purpose of this research is to improve the scalability and performance of the classical MPD algorithm. Correlation thresholds were defined to prune insignificant atoms from the dictionary. The Coarse-Fine Grids and Multiple Atom Extraction techniques were proposed to decrease the computational burden of the algorithm. The Coarse-Fine Grids method enabled the approximation and refinement of the parameters for the best fit atom. The ability to extract multiple atoms within a single iteration enhanced the effectiveness and efficiency of each iteration. These improvements were implemented to produce an improved Matching Pursuit Decomposition algorithm entitled MPD++. Disparate signal decomposition applications may require a particular emphasis of accuracy or computational efficiency. The prominence of the key signal features required for the proper signal classification dictates the level of accuracy necessary in the decomposition. The MPD++ algorithm may be easily adapted to accommodate the imposed requirements. Certain feature extraction applications may require rapid signal decomposition. The full potential of MPD++ may be utilized to produce incredible performance gains while extracting only slightly less energy than the standard algorithm. When the utmost accuracy must be achieved, the modified algorithm extracts atoms more conservatively but still exhibits computational gains over classical MPD. The MPD++ algorithm was demonstrated using an over-complete dictionary on real life data. Computational times were reduced by factors of 1.9 and 44 for the emphases of accuracy and performance, respectively. The modified algorithm extracted similar amounts of energy compared to classical MPD. The degree of the improvement in computational time depends on the complexity of the data, the initialization parameters, and the breadth of the dictionary. The results of the research confirm that the three modifications successfully improved the scalability and computational efficiency of the MPD algorithm. Correlation Thresholding decreased the time complexity by reducing the dictionary size. Multiple Atom Extraction also reduced the time complexity by decreasing

the number of iterations required for a stopping criterion to be reached. The Course-Fine Grids technique enabled complicated atoms with numerous variable parameters to be effectively represented in the dictionary. Due to the nature of the three proposed modifications, they are capable of being stacked and have cumulative effects on the reduction of the time complexity.

Author

*Algorithms; Decomposition; Extraction; Ultrasonics; Signal Analysis; Pattern Recognition; Accuracy*

## 65

### STATISTICS AND PROBABILITY

Includes data sampling and smoothing; Monte Carlo method; time series analysis; and stochastic processes.

**20090034910** Naval Underwater Systems Center, Newport, RI USA

#### **A Tutorial on EM-Based Density Estimation with Histogram Intensity Data**

Ainsleigh, Phillip L; Jun 1, 2009; 69 pp.; In English; Original contains color illustrations

Report No.(s): AD-A505302; NUWC-NPT-TR-11807; No Copyright; Avail.: Defense Technical Information Center (DTIC)

This report examines histogram estimation techniques in which intensity data are represented using a parameterized probability density function (PDF) model. It gives a high-level overview of histogram modeling, introducing the dominant issues and motivations, and then provides detailed mathematical developments of the histogram-based algorithms.

DTIC

*Histograms; Motivation; Estimating*

## 67

### THEORETICAL MATHEMATICS

Includes algebra, functional analysis, geometry, topology, set theory, group theory and number theory.

**20090034909** Science Applications International Corp., San Diego, CA USA

#### **Unified Regional Tomography and Source Moment Tensor Inversions Based on Finite-Difference Strain Green Tensor Databases**

Shen, Yang; Zhang, Wei; Zhang, Zhigang; Zhao, Li; Yang, Xiaoping; Sep 30, 2009; 11 pp.; In English; Original contains color illustrations

Contract(s)/Grant(s): FA8718-06-C-0014; Proj-1010

Report No.(s): AD-A505180; No Copyright; Avail.: Defense Technical Information Center (DTIC)

Seismic monitoring requires accurate source characterization in real time. Accurate 3D earth models are essential for accurate predictions of seismic observables and source characterization. While recovering the true earth structure has always been the goal of tomographic inversions, methods based on full wavefields in 3D reference models have several distinct advantages. Made possible by advances in high-performance computation, this full-wave approach accounts for complex wave propagation in 3D heterogeneous earth, enables fuller utilization of seismic records, and allows us to linearize the inverse problem by iteratively updating the 3D reference model. An important benefit of physically realistic and accurate modeling of wavefields in 3D models is the consistency of the system of equations in inversion. This is particularly important for the integration of different types of observations (P, S, and surface waves including empirical Green's functions derived from ambient noise) in inversion. Two methods have been developed in this field to carry out full-wave tomography iteratively with 3D reference models. One is the adjoint-wavefield (AW) method, which back-propagates the data from the receivers to image the structure. The other is the scattering-integral (SI) method, which constructs the strain Green tensor (SGT) databases and calculates sensitivity kernels for each data functional. Both methods are based on the full-wave theory, and the main differences are in the computational approaches. In general, the adjoint method is CPU intensive, while the SGT-database approach requires a large disk space and fast network. To date, the AW and SI methods use two different approaches in calculating synthetic waveforms, i.e. the spectral-element method and finite-difference (FD) method, respectively. One notable advantage of the SI method is that the SGT databases make it possible to use 3D synthetics in real time seismic monitoring.

DTIC

*Data Bases; Finite Difference Theory; Inversions; Tensors; Tomography*

## 70 PHYSICS (GENERAL)

Includes general research topics related to mechanics, kinetics, magnetism, and electrodynamics. For specific areas of physics see *categories 71 through 77*. For related instrumentation see *35 Instrumentation and Photography*; for geophysics, astrophysics, or solar physics see *46 Geophysics*, *90 Astrophysics*, or *92 Solar Physics*.

**20090035803** Jet Propulsion Lab., California Inst. of Tech., Pasadena, CA, USA

### **A Theoretical Analysis of Steady-State Charge Collection in Simple Diodes under High-Injection Conditions**

Edmonds, Larry D.; September 10, 2009; 50 pp.; In English; Original contains black and white illustrations

Contract(s)/Grant(s): NAS7-03001; WU 071119-1.77

Report No.(s): JPL-Publ-09-21; Copyright; Avail.: CASI: [A03](#), Hardcopy

ONLINE: <http://hdl.handle.net/2060/20090035803>

A previous rigorous mathematical analysis of drift-diffusion equations was used to investigate collected charge in a simple reverse-biased p-n junction diode exposed to an ionization source that liberates carriers (electron-hole pairs) in a quasi-neutral region within the diode. Each of two simple models was found to agree with the more rigorous analysis when carrier liberation is sufficiently intense. One is the sensitive volume (SV) model, and the other was called ambipolar diffusion with a cutoff (ADC). The earlier rigorous analysis was worked out in detail only for a localized source, i.e., a point source of carrier liberation, so it was able to validate the applicability of each simple model only for that case. The present paper treats an arbitrary spatial distribution of carrier generation and concludes that the ADC model remains valid for this more general case, but the SV model does not.

Author

*Diodes; Injection; Steady State; Applications of Mathematics; Mathematical Models; P-N Junctions; Holes (Electron Deficiencies)*

**20090035814** NASA Johnson Space Center, Houston, TX, USA

### **Practical SQUID Instrument for Nondestructive Testing**

Tralshawala, N.; Claycomb, J. R.; Miller, John H., Jr.; Applied Physics Letters; September 1997; ISSN 0003-6951; Volume 71, No. 11, pp. 1573-1575; In English

Contract(s)/Grant(s): NAG 0-905; NAG9-905; Copyright; Avail.: Other Sources

ONLINE: <http://dx.doi.org/10.1063/1.119974>

We report on the development of a scanning eddy-current imaging system designed to detect deep subsurface flaws in conducting materials. A high transition temperature (high-T<sub>c</sub>) superconducting quantum interference device (SQUID) magnetometer is employed to provide the required sensitivity at low frequencies, while a combination of small cylindrical high-T<sub>c</sub> superconducting and A-metal shields enable the instrument to be scanned in a magnetically noisy environment, rather than the object under test. The shields are arranged to prevent unwanted excitation and ambient noise fields from reaching the SQUID, and to enhance spatial resolution and minimize undesirable edge effects. Thus far, the instrument has successfully detected cracks and pits through 10 layers of aluminum, with a combined thickness of 5 cm at room temperature.

Author

*Eddy Currents; Nondestructive Tests; SQUID (Detectors); High Temperature Superconductors; Transition Temperature*

## 71 ACOUSTICS

Includes sound generation, transmission, and attenuation. For noise pollution see *45 Environment Pollution*. For aircraft noise see also *02 Aerodynamics* and *07 Aircraft Propulsion and Power*.

**20090035761** Air Force Inst. of Tech., Wright-Patterson AFB, OH USA

### **Impact of Resolution in Multi-Conjugate Adaptive Optics Systems Using Segmented Mirrors**

Corej, Thomas A.; Schmidt, Jason D.; June 1, 2009; 16 pp.; In English; SPIE Optics and Photonics 2009, 2-6 Aug. 2009, San Diego, CA, USA; Original contains color illustrations

Report No.(s): AD-A504578; AFRL-RD-PS-TP-2009-1015; No Copyright; Avail.: Defense Technical Information Center (DTIC)

ONLINE: <http://hdl.handle.net/100.2/ADA504578>

In moderate-to-strong scintillation, multi-conjugate adaptive optics (MCAO) appears promising to compensate for



amplitude and phase fluctuations. In this research, a MCAO system is simulated with a segmented deformable mirror (DM) reshaping the amplitude and the second DM (continuous) flattening the phase after propagation from the segmented mirror. A Gerchberg-Saxton (GS) type algorithm is used with Fresnel propagation between DM planes. The effects of varying the phase's apparent resolution on a segmented DM in the pupil plane is investigated. Results show the mean square error in the reshaped beam decreases as  $D=r_0$  and Rytov number increase over the range of conditions tested ( $r_0$ : 0.11 m - 0.36 m). The field-estimated Strehl ratio drops precipitously when the number of subapertures is increased beyond about 36 across, using a branch-point- tolerant unwrapper, due to the presence of branch points. On the second DM, by using the mean of the phase within each subaperture before back propagating to the first DM plane (inside the GS loop), the Strehl ratio was improved 6 - 11 percent using 4 - 19 actuators across. Further a novel method of cascading segmented DMs, of increasingly higher resolution, doing amplitude reshaping followed by a continuous DM to flatten the phase is explored.

DTIC

*Adaptive Optics; Conjugates; Segmented Mirrors*

## 74 OPTICS

Includes light phenomena and the theory of optical devices; for specific optical devices see also *35 Instrumentation and Photography*. For lasers see *36 Lasers and Masers*.

**20090034986** MEI Technologies, Inc., Houston, TX, USA

### **Defining Constellation Suit Helmet Field of View Requirements Employing a Mission Segment Based Reduction Process**

McFarland, Shane; July 12, 2009; 16 pp.; In English; International Conference on Environmental Systems, 12-16 Jul. 2009, Savannah, GA, USA; Original contains color and black and white illustrations

Contract(s)/Grant(s): 731384

Report No.(s): JSC-CN-17868; Copyright; Avail.: Other Sources

Field of view has always been a design feature paramount to helmets, and in particular space suits, where the helmet must provide an adequate field of view for a large range of activities, environments, and body positions. For Project Constellation, a different approach to helmet requirement maturation was utilized; one that was less a direct function of body position and suit pressure and more a function of the mission segment in which the field of view will be required. Through taxonomization of various parameters that affect suited field of view, as well as consideration for possible nominal and contingency operations during that mission segment, a reduction process was employed to condense the large number of possible outcomes to only six unique field of view angle requirements that still captured all necessary variables while sacrificing minimal fidelity.

Author

*Space Suits; Helmets; Field of View*

## 80 SOCIAL AND INFORMATION SCIENCES (GENERAL)

Includes general research topics related to sociology; educational programs and curricula. For specific topics in these areas see *categories 81 through 85*.

**20090034890** Psychometrix Associates, Inc., Blacksburg, VA USA

### **Affect, Risk and Uncertainty in Decision-Making: An Integrated Computational-Empirical Approach**

Hudlicka, Eva; Matthews, Gerald; Jul 26, 2009; 64 pp.; In English; Original contains color illustrations

Contract(s)/Grant(s): FA9550-07-C-0055

Report No.(s): AD-A505192; PA-TR-0904; No Copyright; Avail.: Defense Technical Information Center (DTIC)

We summarize a cross-disciplinary effort exploring affective biases in decision-making. The work consisted of an empirical and a computational modeling study, within the same synthetic task: a search-and-rescue task. The empirical study assessed effects of anxiety on decision-making (route selection). Participants were more sensitive to probabilities of costs and benefits, than to their quantitative values. Both threat and anxious mood induction (under low threat) appeared to increase sensitivity to loss. With a neutral emotion-induction, trait anxiety was associated with a classic selective attention basis. Anxious individuals sampled information on potential costs more frequently than information on potential gains. This bias was eliminated in the anxious emotion-induction condition. In the neutral condition, anxious subjects may frame decisions as

requiring vigilance to threat (i.e., elevated attention and analysis), whereas in the anxious condition, the frame is one of escape (requiring less analysis). Computational modeling studies used the MAMID cognitive-affective architecture to construct a process model of anxiety effects: attentional threat and self-bias, and interpretive threat bias. Different levels of anxiety intensities were encoded in different values of architecture parameters, which controlled processing within the architecture modules, yielding results consistent with existing empirical data. The model was also used to construct alternative mechanisms capable of explaining the observed effects, thereby providing a means of generating candidate hypotheses regarding the nature of the processes mediating the biases. Findings make a methodological contribution in demonstrating how experimental emotion-induction can be successfully employed in a task that is longer, more complex and more demanding than those typically used in affective bias research. The data support the validity of the empirical-computational approach of this project.

DTIC

*Decision Making; Bias*

## 81

### ADMINISTRATION AND MANAGEMENT

Includes management planning and research.

**20090035763** Organisatie voor Toegepast Natuurwetenschappelijk Onderzoek, Soesterberg, Netherlands

#### **Evaluation of Transfer of Training**

Veldhuis, G. J.; Theunissen, N. C. M.; June 2009; 52 pp.; In Dutch; Original contains black and white illustrations

Contract(s)/Grant(s): TNO Proj. 013.65051

Report No.(s): TD2009-0140; TNO-DV 2009 B230; Copyright; Avail.: Other Sources

Transfer of Training is the way trainees are able to perform what they have learned during training in their jobs. At the start of this project no ready to use method was available to assess transfer of training in real technical training situations. Therefore we developed a method to investigate what stakeholders (instructors, trainees and managers) do to enhance transfer of training. This method consists of a total of nine questionnaires (for each stakeholder one before, during and after training) and an instrument to assess task performance both during training and at the workplace. The results show that stakeholders vary in the way they support transfer of training. The data show that three 'before training factors' can positively influence transfer of training factors during training: Trainees prepare for training, trainers facilitate trainees to prepare for training, and managers propagate relevance, importance of training. The results consist of an approach to improve transfer of training. Follow-up activities must reveal the impact of these improvements on transfer of training. The research findings are presented to stakeholders on all organizational levels. Stakeholders recognized and under scribe the findings, and are willing to improve training effectiveness.

Author

*Education; Transfer of Training; Human Performance; Training Evaluation; Training Devices*

## 82

### DOCUMENTATION AND INFORMATION SCIENCE

Includes information management; information storage and retrieval technology; technical writing; graphic arts; and micrography. For computer program documentation see *61 Computer Programming and Software*.

**20090034905** Government Accountability Office, Washington, DC, USA

#### **Information Technology: HUD Needs to Strengthen Its Capacity to Manage and Modernize Its Environment**

Jul. 2009; 52 pp.; In English

Report No.(s): PB2009-113662; GAO-09-675; No Copyright; Avail.: CASI: [A04](#), Hardcopy

Information technology (IT) plays a critical role in the Department of Housing and Urban Development's (HUD) ability to carry out its home ownership and community development mission, which was recently expanded under the Housing and Economic Recovery Act of 2008. Pursuant to a congressional mandate to study HUD's IT environment, GAO reviewed the adequacy of key IT management and modernization controls within the department, including strategic planning and performance measurement, investment management, human capital management, enterprise architecture development and use,

and modernization program office establishment. To do so, GAO compared HUD policies, guidance, plans, reports, and other products and actions to relevant aspects of statutory requirements, federal guidance, and related best practices.

NTIS

*Information Systems; Procedures; Policies*

**20090034920** Rhode Island Univ., Kingston, RI USA

**Progress Towards Next Generation, Waveform Based Three-Dimensional Models and Metrics to Improve Nuclear Explosion Monitoring in the Middle East**

Savage, Brian; Peter, Daniel; Covellone, Brian M; Rodgers, Arthur J; Tromp, Jeroen; Sep 30, 2009; 8 pp.; In English; Original contains color illustrations

Contract(s)/Grant(s): FA8718-08-C-0009; Proj-1010

Report No.(s): AD-A505269; No Copyright; Avail.: Defense Technical Information Center (DTIC)

Efforts to update current wave speed models of the Middle East require a thoroughly tested database of sources and recordings. Recordings of seismic waves traversing the region from Tibet to the Red Sea will be the principal metric in guiding improvements to the current wave speed model. Precise characterizations of the earthquakes, specifically depths and faulting mechanisms, are essential to avoid mapping source errors into the refined wave speed model. Errors associated with the source are manifested in amplitude and phase changes. Source depths and paths near nodal planes are particularly error prone as small changes may severely affect the resulting wavefield. Once sources are quantified, regions requiring refinement will be highlighted using adjoint tomography methods based on spectral element simulations (Komatitsch and Tromp, 1999). An initial database of 250 regional Middle Eastern events from 1990-2007, was inverted for depth and focal mechanism using teleseismic arrivals (Kikuchi and Kanamori, 1982) and regional surface and body waves (Zhao and Helmberger, 1994). From this initial database, we reinterpreted a large, well-recorded subset of 201 events through a direct comparison between data and synthetics based upon a centroid moment tensor inversion (Liu et al., 2004). Evaluation was done using both a 1D reference model (Dziewonski and Anderson, 1981) at periods greater than 80 seconds and a 3D model (Kustowski et al., 2008) at periods of 25 seconds and longer. The final source reinterpretations will be within the 3D model, as this is the initial starting point for the adjoint tomography. Transitioning from a 1D to 3D wave speed model shows dramatic improvements when comparisons are done at shorter periods, e.g., 25 s. Synthetics from the 1D model were created through mode summations while those from the 3D simulations were created using the spectral element method. To further assess errors in source depth and focal mechanism, comparisons between the two

DTIC

*Data Bases; Middle East; Nuclear Explosions; Three Dimensional Models; Waveforms*

**20090034924** Defence Research and Development Canada, Toronto, Ontario Canada

**DRDC Toronto Guidelines for Compensation of Subjects Participating in Research Studies**

Duncan, Matthew; Eaton, David; Hendriks, Tonya; Keefe, Allan; McLellan, Tom M; Michas, Robert D; Thompson, Megan M; Sep 2008; 48 pp.; In English; Original contains color illustrations

Report No.(s): AD-A504483; DRDC-TORONTO-TM-2008-138; No Copyright; Avail.: Defense Technical Information Center (DTIC)

ONLINE: <http://hdl.handle.net/100.2/ADA504483>

DRDC Toronto is the Agency's research centre that provides guidance, innovation and knowledge about the human's response to the complex and stressful environments that impact CF members in preparation for, during and following humanitarian, peace-keeping and warfighting operations. The Agency has invested in DRDC Toronto to ensure that we can simulate and study these responses with human experimentation conducted by our scientists during in-house laboratory or field experimentation. Central to this capability is the need to recruit subjects, both military and civilian, that are willing to experience certain degrees of stress that are beyond what they would experience during their normal day, and/or that are willing to commit the time for participation that enables the study to be completed in an appropriate time-frame. New consolidated guidelines were needed to establish consistent and transparent procedures for generating rates of compensation that would still enable free and informed consent to be obtained according to Tri-Council Policy guidelines. The new guidelines are intended to be applicable for all studies involving human subjects at DRDC Toronto and perhaps could be extended, in principle, across the Agency. The report includes the rationale behind the development of these new guidelines together with examples of how to use the spreadsheet that will be available for all scientific and technical staff to apply to their studies.

DTIC

*Manuals; Human Beings; Field Tests*

**20090034925** Defence Research and Development Canada, Toronto, Ontario Canada

**The Logic of Definition**

Moore, James W; May 2009; 17 pp.; In English; Original contains color illustrations

Report No.(s): AD-A504542; DRDC-TORONTO-TN-2009-082; No Copyright; Avail.: Defense Technical Information Center (DTIC)

ONLINE: <http://hdl.handle.net/100.2/ADA504542>

Voltaire's admonition to define your terms has become a bedrock maxim of science, whether in the physical, social or military sciences. Why do we as Defence Scientists attach such importance to the process of definition? First and foremost, definitions (ideally) provide semantic clarity, clarifying ambiguous and vague terms and, hence, mitigating terminological confusion, a critical imperative particularly in combined or multinational (and multilingual) military operations. Moreover, standardized terminology can enhance situational awareness, to the extent that it assists in identifying and describing features of the strategic, operational and/or tactical environment in commonly understood language. Finally, univocal terms and concepts (that is, terms and concepts that have only one meaning or sense) are the building blocks of the defence scientific enterprise. Precise definition is necessary if these terms are to be applied to extant phenomena without question or doubt. Moreover, as Robinson points out, science requires universal agreement...on the inferences that can be drawn from those terms when they are combined into propositions. Safe and agreed inferences are possible only with precise and unambiguous terms (Robinson 1950: 70). What follows in this Technical Note is a discussion of the logic of definition, illustrating some of the basic terminology, types and methods used in this essential intellectual activity.

DTIC

*Physical Sciences; Terminology; Identifying*

**20090035011** National Inst. of Standards and Technology, Gaithersburg, MD, USA

**Framework for XML Schema Naming and Design Rules Development Tools**

Morris, K. C.; Lubell, J.; Malick, S. S.; Jul. 2009; 15 pp.; In English

Report No.(s): PB2009-113656; NISTIR-7589; No Copyright; Avail.: CASI: A03, Hardcopy

Manufacturing industry is facing an enormous challenge today in trying to integrate a wide range of software systems. These systems span the functional areas of manufacturing, as well as, the multitude of organizations and countries involved in the manufacture of their products. To address these needs (and similar needs in other industries) a number of organizations are defining standards that support the integration of the systems. Many of these standards are an application of the XML family of software standards. To ensure quality in the emerging domain standards, the organizations producing them also define guidelines for how the XML standards, especially XML Schema, will be used in a given context. These guidelines are published as sets of Naming and Design Rules (NDR). Unfortunately, a single set of these rules do not meet the needs of the wide range of standards being developed. Moreover, the guidelines are being published as prose (e.g., English text) rather than in a computational form. To address these shortcomings and allow for the more rapid creation of high quality NDR, NIST is developing a set of tools to facilitate Naming and Design Rules Development. The tools support the development of executable tests to support NDR, collaboration on the use of those tests, the grouping of tests into testing profiles, as well as, the association of NDR documentation with executable tests. The grouping mechanism allows rules to be selected from a larger set for use in a particular context. By also providing for the association of guidelines with executable tests, a testing suite can be quickly assembled. Furthermore, the pool of guidelines and their tests can be collaboratively developed, thereby leveraging resources and creating higher quality test sets in the end. The report describes a roadmap for the use of these tools in the development of XML Schema Naming and Design Rules. It is produced by the XML Testbed project within the Manufacturing Systems Integration Division at NIST. These tools aid in producing high quality XML schemas using a standards-based approach to manufacturing systems integration. The tools are based on open-standards, making them highly configurable and reusable. The three primary functional areas of the tools described are authoring, testing, and sharing.

NTIS

*Document Markup Languages; Industries; Manufacturing; Naming; Software Engineering*

**20090035568** Institute of Museum and Library Services, Washington, DC, USA

**Museums and Libraries Engaging America's Youth: Final Report of a Study of IMLS Youth Programs, 1998-2003**

Dec. 2007; 140 pp.; In English

Report No.(s): PB2009-113010; No Copyright; Avail.: National Technical Information Service (NTIS)

The Institute of Museum and Library Services helps museums and libraries preserve our cultural heritage, enhance learning and innovation, and develop staff capacities to provide the best in service to our communities. Museums and Libraries Engaging America's Youth looks at the contributions of IMLS grants from 1998 through 2003 to quality programs and positive

outcomes for youth aged 9-19, with four key goals: 1) Identify results, trends, and characteristics of these projects. 2) Help strengthen programs and community partnerships for youth development. 3) Offer models of excellence and practical guidelines for youth programs. 4) Understand IMLS projects in a national context of youth development efforts. The study started with a widely used framework called Positive Youth Development (PYD) (Lerner et al. 2005). The model highlights the internal assets we want for youth commitment to learning, positive values, social competencies, and positive identity and the environmental and program features that support and empower youth to develop the assets they need.

NTIS

*Libraries; Museums; Youth*

**20090035570** Institute of Museum and Library Services, Washington, DC, USA

**Nine to Nineteen: Youth in Museums and Libraries: A Practitioner's Guide**

Apr. 2008; 36 pp.; In English

Report No.(s): PB2009-112991; No Copyright; Avail.: CASI: [A03](#), Hardcopy

This guide grew out of the Institute of Museum and Library Services Museums and Libraries Engaging America's Youth initiative and draws on the wide body of research and knowledge from the fields of youth development and informal learning, as well as from the rich experience of museum and library professionals and volunteers. The specific goals of the initiative are: to examine what works to share best practices to encourage effective programming to build bridges with policy makers To examine what works, IMLS undertook a yearlong study, which consisted of a survey of 400 youth programs for youth aged 9-19 conducted at museums and libraries across the nation that had been supported by IMLS between 1998 and 2003; a series of workshops; and the development of case studies. The study looked at the practices that contributed to successful and sustainable programs and reports on its findings in the Museums and Libraries Engaging Americas. To meet the initiatives other goals, IMLS is issuing a series of publications and Web resources, and will continue to provide grant funding for innovative youth programs.

NTIS

*Libraries; Museums; Youth; Learning*

**20090035636** Marine Corps Univ., Quantico, VA USA

**Automated Access and Analysis in Counter Network Operations**

Ferguson, Robert S; Jan 2007; 26 pp.; In English

Report No.(s): AD-A504786; No Copyright; Avail.: Defense Technical Information Center (DTIC)

ONLINE: <http://hdl.handle.net/100.2/ADA504786>

The USA increasingly will likely oppose dark networked adversaries rather than only traditional nation states in future conflicts. These dark networked adversaries use a network form of organization and conduct activities that are both illegal and often secret. The IC, because of its Cold War hierarchical structure, is generally not as well equipped to counter this adversary as it is against a traditional nation state foe. Its hierarchical form limits effective information exchange. In order to counter dark networks more effectively, the IC must enable wider access to the large number of data sources both inside and outside US government control. This requires an examination of how it ensures information security and tags data for retrieval. Once the IC achieves wider data access, it must develop automated retrieval and analysis tools that can rapidly sort and link the large amount of data that would be available to intelligence analysts. These tools will facilitate improved understanding of dark networks adversaries and enable better decisions in future conflicts against them. By leveraging wider access to global data and processing that data using automated retrieval and analysis tools, the IC will better understand the terrain of network adversaries, facilitating more informed counter network decisions.

DTIC

*Countermeasures; Data Transmission; Network Analysis; Networks; Security*

**20090035691** National Security Agency, Fort Meade, MD, USA

**Meeting Critical Security Objectives with Security-Enhanced Linux**

Loscocco, P. A.; Smalley, S. D.; January 2005; 11 pp.; In English

Report No.(s): PB2009-114069; No Copyright; Avail.: CASI: [A03](#), Hardcopy

Security-enhanced Linux incorporates a strong, flexible mandatory access control architecture into Linux. It provides a mechanism to enforce the separation of information based on confidentiality and integrity requirements. This allows threats of tampering and bypassing of application security mechanisms to be addressed and enables the confinement of damage that can be caused by malicious or flawed applications. Using the systems type enforcement and role-based access control



abstractions, it is possible to configure the system to meet a wide range of security needs. This paper describes how Security-enhanced Linux was used to meet a number of general-purpose system security objectives.

NTIS

*Security; Unix (Operating System); Access Control*

**20090035693** National Security Agency, Fort Meade, MD, USA

**Securing The X Window System with SELinux**

Kilpatrick, D.; Salamon, W.; Vance, C.; Mar. 2003; 33 pp.; In English

Report No.(s): PB2009-114065; No Copyright; Avail.: CASI: [A03](#), Hardcopy

The X Window System, or X11, has become the standard graphical engine for the Unix and Linux operating systems. Its network-based design and platform independent support for a wide range of operating systems and hardware has contributed greatly to its acceptance (XOrgIntro). The X protocol was designed with compatibility and performance in mind, not security. However, since the X protocol is a constrained channel of communication, it enables the enforcement of a security policy. While there has been quite a bit of research done in the past to secure X11, many solutions are specific to the governments Multi-Level Security (MLS) model, and are not in widespread use. NSA Security-Enhanced Linux (SELinux) is an implementation of Flask, a flexible and fine-grained mandatory access control (MAC) architecture (FlaskArch). SELinux can enforce an administratively defined security policy over all processes and objects in the system, basing decisions on labels containing a variety of security-relevant information. The architecture provides flexibility by cleanly separating the policy decision-making logic from the policy enforcement logic. The policy decision-making logic is encapsulated within a single component, known as the security server, with a general security interface. A wide range of security models can be implemented as security servers without requiring any changes to any other component of the system. The design and implementation of the SELinux prototype is described in (LoscoccoFreenix2001) and (LoscoccoNSATR2001), both of which can be found at the NSA SELinux web site (<http://www.nsa.gov/selinux>). On a current SELinux system, applications can use the X server as an additional communications vector, unregulated by the system policy. In addition, applications can manipulate the X server to attack other client applications, or to mislead the user. By running the X Server on an SELinux system, and by extending the FLASK architecture to allow the X Server to act as a trusted application, the security of the user operating environment should be enhanced.

NTIS

*Microwave Landing Systems; Security; Warning Systems; Access Control*

**20090035750** Central Intelligence Agency, Washington, DC USA

**Studies in Intelligence, Volume 53, No. 2. Intelligence in Contemporary Media: Views of Intelligence Officers**

July 2009; 57 pp.; In English; Original contains color illustrations

Report No.(s): AD-A504946; No Copyright; Avail.: Defense Technical Information Center (DTIC)

ONLINE: <http://hdl.handle.net/100.2/ADA504946>

One of the least appreciated facts about the intelligence profession is that it exists in, and is influenced by, a very complex environment. The public is a particularly important part of this environment. But unlike military services, intelligence organizations do not have recruitment centers in every mid-sized town; nor do most families have some member who has served in intelligence. Hence, what most in the public think about intelligence depends to a large extent on what they see in cinematic, documentary, and novelistic sources like those reviewed in this issue. This is particularly the case in the USA. As the reviewers make clear, what the public sees and reads is with rare exception fantasy mixed with a few kernels of truth. This is particularly true when it comes to American authors and directors. We have not yet produced an espionage novelist with the maturity and perfect pitch so frequently found in the work of British masters such as John le Carr. As important as detail is to all art, what often lingers is a dominant impression?what you remember days, weeks, or years after seeing a film or reading a novel. And in that respect, what I take from these reviews is modestly reassuring. When you look at all of the recent films about espionage, what lingers are several broad impressions: intelligence officers are often courageous, prepared to stand on principle, forced frequently to deal with stressful or ambiguous circumstances, and quite willing to take risks. So enjoy the Intelligence in Contemporary Media section of this issue of Studies in Intelligence and take heart from the thought that if life truly does imitate art, that would not be an entirely bad thing in the case of espionage.

DTIC

*Intelligence; Summer*

**20090035798** Jet Propulsion Lab., California Inst. of Tech., Pasadena, CA, USA

**NASA Engineering Network (NEN)**

Topousis, Daria; Trevarthen, Ellie; Yew, Manson; February 26, 2008; 18 pp.; In English; PM Challenge 2008, 26 Feb. 2008, Daytona Beach, FL, USA; Original contains color illustrations; Copyright; Avail.: Other Sources

ONLINE: <http://hdl.handle.net/2014/41386>

This slide presentation reviews the NASA Engineering Network (NEN). NEN is designed to search documents over multiple repositories, submit and browse NASA Lessons Learned, collaborate and share ideas with other engineers via communities of practice, access resources from one portal, and find subject matter experts via the People, Organizations, Projects, Skills (POPS) locator.

CASI

*Engineers; Information Retrieval; Information Dissemination; Information Transfer*

**84**

**LAW, POLITICAL SCIENCE AND SPACE POLICY**

Includes aviation law; space law and policy; international law; international cooperation; and patent policy.

**20090034896** National Academy of Sciences - National Research Council, Washington, DC, USA

**America's Future in Space: Aligning the Civil Space Program with National Needs**

2009; 25 pp.; In English; Copyright; Avail.: Other Sources

As civil space policies and programs have evolved, the geopolitical environment has changed dramatically. Although the U.S. space program was originally driven in large part by competition with the Soviet Union, the nation now finds itself in a post-Cold War world in which many nations have established, or are aspiring to develop, independent space capabilities. Furthermore discoveries from developments in the first 50 years of the space age have led to an explosion of scientific and engineering knowledge and practical applications of space technology. The private sector has also been developing, fielding, and expanding the commercial use of space-based technology and systems. Recognizing the new national and international context for space activities, America's Future in Space is meant to advise the nation on key goals and critical issues in 21st century U.S. civil space policy.

Author

*International Relations; Policies; Space Programs*

**85**

**TECHNOLOGY UTILIZATION AND SURFACE TRANSPORTATION**

Includes aerospace technology transfer; urban technology; surface and mass transportation. For related information see also *03 Air Transportation and Safety*, *16 Space Transportation and Safety*, and *44 Energy Production and Conversion*. For specific technology transfer applications see also the category where the subject is treated.

**20090035873** NASA, Washington, DC, USA

**NASA Tech Briefs, October 2009**

October 2009; 38 pp.; In English; See also 20090035874 - 20090035906; Original contains color illustrations; Copyright; Avail.: CASI: [A03](#), Hardcopy

ONLINE: <http://hdl.handle.net/2060/20090035873>

Topics covered include: Light-Driven Polymeric Bimorph Actuators; Guaranteeing Failsafe Operation of Extended-Scene Shack-Hartmann Wavefront Sensor Algorithm; Cloud Water Content Sensor for Sounding Balloons and Small UAVs; Pixelized Device Control Actuators for Large Adaptive Optics; T-Slide Linear Actuators; G4FET Implementations of Some Logic Circuits; Electrically Variable or Programmable Nonvolatile Capacitors; System for Automated Calibration of Vector Modulators; Complementary Paired G4FETs as Voltage-Controlled NDR Device; Three MMIC Amplifiers for the 120-to-200 GHz Frequency Band; Low-Noise MMIC Amplifiers for 120 to 180 GHz; Using Ozone To Clean and Passivate Oxygen-Handling Hardware; Metal Standards for Waveguide Characterization of Materials; Two-Piece Screens for Decontaminating Granular Material; Mercuric Iodide Anticoincidence Shield for Gamma-Ray Spectrometer; Improved Method of Design for Folding Inflatable Shells; Ultra-Large Solar Sail; Cooperative Three-Robot System for Traversing Steep Slopes; Assemblies of Conformal Tanks; Microfluidic Pumps Containing Teflon[Trademark] AF Diaphragms; Transparent Conveyor of Dielectric Liquids or Particles; Multi-Cone Model for Estimating GPS Ionospheric Delays; High-Sensitivity GaN

Microchemical Sensors; On the Divergence of the Velocity Vector in Real-Gas Flow; Progress Toward a Compact, Highly Stable Ion Clock; Instruments for Imaging from Far to Near; Reflectors Made from Membranes Stretched Between Beams; Integrated Risk and Knowledge Management Program -- IRKM-P; LDPC Codes with Minimum Distance Proportional to Block Size; Constructing LDPC Codes from Loop-Free Encoding Modules; MMICs with Radial Probe Transitions to Waveguides; Tests of Low-Noise MMIC Amplifier Module at 290 to 340 GHz; and Extending Newtonian Dynamics to Include Stochastic Processes.

Author

*Adaptive Optics; Waveguides; Risk Management; Actuators; Decontamination; Ozone; Calibrating; Electric Potential; Global Positioning System; Gamma Ray Spectrometers; Integrated Circuits*

**20090035874** DxRay, Inc., USA

#### **Mercuric Iodide Anticoincidence Shield for Gamma-Ray Spectrometer**

Hartsough, Neal; Iwanczyk, Jan; NASA Tech Briefs, October 2009; October 2009, pp. 17; In English; See also [20090035873](#) Report No.(s): GSC-15635-1; Copyright; Avail.: CASI: [A01](#), Hardcopy

ONLINE: <http://hdl.handle.net/2060/20090035874>; <http://www.techbriefs.com/component/content/article/5770>

A film-growth process was developed for polycrystalline mercuric iodide that creates cost-effective, large-area detectors for high-energy charged-particle detection. A material, called a barrier film, is introduced onto the substrate before the normal mercuric iodide film growth process. The barrier film improves the quality of the normal film grown and enhances the adhesion between the film and the substrate. The films grown using this improved technique were found to have adequate signal-to-noise properties so that individual high-energy charged -particle interactions could be distinguished from noise, and thus, could be used to provide an anticoincidence veto function as desired.

Author

*Mercury Compounds; Iodides; Gamma Ray Spectrometers; Anticoincidence Detectors; Polycrystals; Charged Particles; Adhesion*

**20090035875** California Inst. of Tech., Pasadena, CA, USA

#### **G(sup 4)FET Implementations of Some Logic Circuits**

Mojarradi, Mohammad; Akarvardar, Kerem; Cristoleveanu, Sorin; Gentil, Paul; Blalock, Benjamin; Chen, Suhan; NASA Tech Briefs, October 2009; October 2009, pp. 9-10; In English; See also [20090035873](#); Original contains color illustrations

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Some logic circuits have been built and demonstrated to work substantially as intended, all as part of a continuing effort to exploit the high degrees of design flexibility and functionality of the electronic devices known as G(sup 4)FETs and described below. These logic circuits are intended to serve as prototypes of more complex advanced programmable-logicdevice-type integrated circuits, including field-programmable gate arrays (FPGAs). In comparison with prior FPGAs, these advanced FPGAs could be much more efficient because the functionality of G(sup 4)FETs is such that fewer discrete components are needed to perform a given logic function in G(sup 4)FET circuitry than are needed perform the same logic function in conventional transistor-based circuitry. The underlying concept of using G(sup 4)FETs as building blocks of programmable logic circuitry was also described, from a different perspective, in G(sup 4)FETs as Universal and Programmable Logic Gates (NPO-41698), NASA Tech Briefs, Vol. 31, No. 7 (July 2007), page 44. A G(sup 4)FET can be characterized as an accumulation-mode silicon-on-insulator (SOI) metal oxide/semiconductor field-effect transistor (MOSFET) featuring two junction field-effect transistor (JFET) gates. The structure of a G(sup 4)FET (see Figure 1) is the same as that of a p-channel inversion-mode SOI MOSFET with two body contacts on each side of the channel. The top gate (G1), the substrate emulating a back gate (G2), and the junction gates (JG1 and JG2) can be biased independently of each other and, hence, each can be used to independently control some aspects of the conduction characteristics of the transistor. The independence of the actions of the four gates is what affords the enhanced functionality and design flexibility of G(sup 4)FETs. The present G(sup 4)FET logic circuits include an adjustable-threshold inverter, a real-time-reconfigurable logic gate, and a dynamic random-access memory (DRAM) cell (see Figure 2). The configuration of the adjustable-threshold inverter is similar to that of an ordinary complementary metal oxide semiconductor (CMOS) inverter except that an NMOSFET (a MOSFET having an n-doped channel and a p-doped Si substrate) is replaced by an n-channel G(sup 4)FET

Author

*Field Effect Transistors; Field-Programmable Gate Arrays; Gates (Circuits); Integrated Circuits; Doped Crystals; Random Access Memory; Metal Oxide Semiconductors; SOI (Semiconductors)*

**20090035876** NASA Glenn Research Center, Cleveland, OH, USA

#### **Light-Driven Polymeric Bimorph Actuators**

Adamovsky, Gregory; Sarkisov, Sergey S.; Curley, Michael J.; NASA Tech Briefs, October 2009; October 2009, pp. 5; In English; See also [20090035873](#); Original contains color illustrations

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Light-driven polymeric bimorph actuators are being developed as alternatives to prior electrically and optically driven actuators in advanced, highly miniaturized devices and systems exemplified by microelectromechanical systems (MEMS), micro-electro-optical-mechanical systems (MEOMS), and sensor and actuator arrays in smart structures. These light-driven polymeric bimorph actuators are intended to satisfy a need for actuators that (1) in comparison with the prior actuators, are simpler and less power-hungry; (2) can be driven by low-power visible or mid-infrared light delivered through conventional optic fibers; and (3) are suitable for integration with optical sensors and multiple actuators of the same or different type. The immediate predecessors of the present light-driven polymeric bimorph actuators are bimorph actuators that exploit a photostrictive effect in lead lanthanum zirconate titanate (PLZT) ceramics. The disadvantages of the PLZT-based actuators are that (1) it is difficult to shape the PLZT ceramics, which are hard and brittle; (2) for actuation, it is necessary to use ultraviolet light (wavelengths < 380 nm), which must be generated by use of high-power, high-pressure arc lamps or lasers; (3) it is difficult to deliver sufficient ultraviolet light through conventional optical fibers because of significant losses in the fibers; (4) the response times of the PLZT actuators are of the order of several seconds unacceptably long for typical applications; and (5) the maximum mechanical displacements of the PLZT-based actuators are limited to those characterized by low strains beyond which PLZT ceramics disintegrate because of their brittleness. The basic element of a light-driven bimorph actuator of the present developmental type is a cantilever beam comprising two layers, at least one of which is a polymer that exhibits a photomechanical effect (see figure). The dominant mechanism of the photomechanical effect is a photothermal one: absorption of light energy causes heating, which, in turn, causes thermal expansion.

Author

*Actuators; Photomechanical Effect; Microelectromechanical Systems; Electromagnetic Absorption; Ceramics; Arc Lamps; Ultraviolet Radiation; Thermal Expansion; Optical Measuring Instruments; Lanthanum Compounds*

**20090035877** California Inst. of Tech., Pasadena, CA, USA

#### **Cooperative Three-Robot System for Traversing Steep Slopes**

Stroupe, Ashley; Huntsberger, Terrance; Aghazarian, Hrand; Younse, Paulo; Garrett, Michael; NASA Tech Briefs, October 2009; October 2009, pp. 19-20; In English; See also [20090035873](#); Original contains color illustrations

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ONLINE: <http://hdl.handle.net/2060/20090035877>; <http://www.techbriefs.com/component/content/article/5779>

Teamed Robots for Exploration and Science in Steep Areas (TRESSA) is a system of three autonomous mobile robots that cooperate with each other to enable scientific exploration of steep terrain (slope angles up to 90°). Originally intended for use in exploring steep slopes on Mars that are not accessible to lone wheeled robots (Mars Exploration Rovers), TRESSA and systems like TRESSA could also be used on Earth for performing rescues on steep slopes and for exploring steep slopes that are too remote or too dangerous to be explored by humans. TRESSA is modeled on safe human climbing of steep slopes, two key features of which are teamwork and safety tethers. Two of the autonomous robots, denoted Anchorbots, remain at the top of a slope; the third robot, denoted the Cliffbot, traverses the slope. The Cliffbot drives over the cliff edge supported by tethers, which are payed out from the Anchorbots (see figure). The Anchorbots autonomously control the tension in the tethers to counter the gravitational force on the Cliffbot. The tethers are payed out and reeled in as needed, keeping the body of the Cliffbot oriented approximately parallel to the local terrain surface and preventing wheel slip by controlling the speed of descent or ascent, thereby enabling the Cliffbot to drive freely up, down, or across the slope. Due to the interactive nature of the three-robot system, the robots must be very tightly coupled. To provide for this tight coupling, the TRESSA software architecture is built on a combination of (1) the multi-robot layered behavior-coordination architecture reported in 'An Architecture for Controlling Multiple Robots' (NPO-30345), NASA Tech Briefs, Vol. 28, No. 10 (October 2004), page 65, and (2) the real-time control architecture reported in 'Robot Electronics Architecture' (NPO-41784), NASA Tech Briefs, Vol. 32, No. 1 (January 2008), page 28. The combination architecture makes it possible to keep the three robots synchronized and coordinated, to use data from all three robots for decision-making at each step, and to control the physical connections among the robots. In addition, TRESSA (as in prior systems that have utilized this architecture), incorporates a capability for deterministic response to unanticipated situations from yet another architecture reported in Control Architecture for Robotic Agent Command and Sensing (NPO-43635), NASA Tech Briefs, Vol. 32, No. 10 (October 2008), page 40. Tether tension control is a major consideration in the design and operation of TRESSA. Tension is measured by force sensors connected to



each tether at the Cliffbot. The direction of the tension (both azimuth and elevation) is also measured. The tension controller combines a controller to counter gravitational force and an optional velocity controller that anticipates the motion of the Cliffbot. The gravity controller estimates the slope angle from the inclination of the tethers. This angle and the weight of the Cliffbot determine the total tension needed to counteract the weight of the Cliffbot. The total needed tension is broken into components for each Anchorbot. The difference between this needed tension and the tension measured at the Cliffbot constitutes an error signal that is provided to the gravity controller. The velocity controller computes the tether speed needed to produce the desired motion of the Cliffbot. Another major consideration in the design and operation of TRESSA is detection of faults. Each robot in the TRESSA system monitors its own performance and the performance of its teammates in order to detect any system faults and prevent unsafe conditions. At startup, communication links are tested and if any robot is not communicating, the system refuses to execute any motion commands. Prior to motion, the Anchorbots attempt to set tensions in the tethers at optimal levels for counteracting the weight of the Cliffbot; if either Anchorbot fails to reach its optimal tension level within a specified time, it sends message to the other robots and the commanded motion is not executed. If any mechanical error (e.g., stalling of a motor) is detected, the affected robot sends a message triggering stoppage of the current motion. Lastly, messages are passed among the robots at each time step (10 Hz) to share sensor information during operations. If messages from any robot cease for more than an allowable time interval, the other robots detect the communication loss and initiate stoppage.

Author

*Robots; Roving Vehicles; Mars Exploration; Ascent; Slopes; Terrain; Tethering; Estimates; Controllers; Communication Networks; Cliffs*

**20090035878** NASA Marshall Space Flight Center, Huntsville, AL, USA

#### **Assemblies of Conformal Tanks**

DeLay, Tom; NASA Tech Briefs, October 2009; October 2009, pp. 20-21; In English; See also [20090035873](#); Original contains color illustrations

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Assemblies of tanks having shapes that conform to each other and/or conform to other proximate objects have been investigated for use in storing fuels and oxidizers in small available spaces in upper stages of spacecraft. Such assemblies might also prove useful in aircraft, automobiles, boats, and other terrestrial vehicles in which space available for tanks is limited. The basic concept of using conformal tanks to maximize the utilization of limited space is not new in itself: for example, conformal tanks are used in some automobiles to store windshield -washer liquid and coolant that overflows from radiators. The novelty of the present development lies in the concept of an assembly of smaller conformal tanks, as distinguished from a single larger conformal tank. In an assembly of smaller tanks, it would be possible to store different liquids in different tanks. Even if the same liquid were stored in all the tanks, the assembly would offer an advantage by reducing the mechanical disturbance caused by sloshing of fuel in a single larger tank: indeed, the requirement to reduce sloshing is critical in some applications. The figure shows a prototype assembly of conformal tanks. Each tank was fabricated by (1) copper plating a wax tank mandrel to form a liner and (2) wrapping and curing layers of graphite/epoxy composite to form a shell supporting the liner. In this case, the conformal tank surfaces are flat ones where they come in contact with the adjacent tanks. A band of fibers around the outside binds the tanks together tightly in the assembly, which has a quasi-toroidal shape. For proper functioning, it would be necessary to maintain equal pressure in all the tanks.

Author

*Storage Tanks; Fuels; Oxidizers; Composite Structures; Graphite-Epoxy Composites; Shells (Structural Forms); Liquid Sloshing; Coolants*

**20090035879** California Inst. of Tech., Pasadena, CA, USA

#### **Reflectors Made from Membranes Stretched Between Beams**

Dooley, Jennifer; Dragovan, Mark; Tolomeo, Jason; NASA Tech Briefs, October 2009; October 2009, pp. 28; In English; See also [20090035873](#); Original contains color illustrations

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Lightweight cylindrical reflectors of a proposed type would be made from reflective membranes stretched between pairs of identically curved and identically oriented end rails. In each such reflector, the curvature of the two beams would define the reflector shape required for the intended application. For example, the beams could be curved to define a reflector of parabolic cross section, so that light incident along the axis of symmetry perpendicular to the cylindrical axis would be focused



to a line. In addition, by applying suitable forces to the ends of the beams, one could bend the beams to adjust the reflector surface figure to within a precision of the order of the wavelength of the radiation to be reflected. The figure depicts an example of beams shaped so that in the absence of applied forces, each would be flat on one side and would have a radius of curvature  $R$  on the opposite side. Alternatively, the curvature of the reflector-membrane side could be other than circular. In general, the initial curvature would be chosen to optimize the final reflector shape. Then by applying forces  $F$  between the beam ends in the positions and orientations shown in the figure, one could bend beams to adjust their shape to a closer approximation of the desired precise circular or noncircular curvature.

Author

*Reflectors; Cylindrical Bodies; Membranes; Symmetry; Stretching; Precision*

**20090035881** Houston Univ., Houston, TX, USA

**Electrically Variable or Programmable Nonvolatile Capacitors**

Shangqing, Liu; NaiJuan, Wu; Ignatieu, Alex; Jianren, Li; NASA Tech Briefs, October 2009; October 2009, pp. 10-11; In English; See also [20090035873](#); Original contains color illustrations

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ONLINE: <http://hdl.handle.net/2060/20090035881>; <http://www.techbriefs.com/component/content/article/5773>

Electrically variable or programmable capacitors based on the unique properties of thin perovskite films are undergoing development. These capacitors show promise of overcoming two important deficiencies of prior electrically programmable capacitors: Unlike in the case of varactors, it is not necessary to supply power continuously to make these capacitors retain their capacitance values. Hence, these capacitors may prove useful as components of nonvolatile analog and digital electronic memories. Unlike in the case of ferroelectric capacitors, it is possible to measure the capacitance values of these capacitors without changing the values. In other words, whereas readout of ferroelectric capacitors is destructive, readout of these capacitors can be nondestructive. A capacitor of this type is a simple two terminal device. It includes a thin film of a suitable perovskite as the dielectric layer, sandwiched between two metal or metal oxide electrodes (for example, see Figure 1). The utility of this device as a variable capacitor is based on a phenomenon, known as electrical-pulse-induced capacitance (EPIC), that is observed in thin perovskite films and especially in those thin perovskite films that exhibit the colossal magnetoresistive (CMR) effect. In EPIC, the application of one or more electrical pulses that exceed a threshold magnitude (typically somewhat less than 1 V) gives rise to a nonvolatile change in capacitance. The change in capacitance depends on the magnitude duration, polarity, and number of pulses. It is not necessary to apply a magnetic field or to cool the device below (or heat it above) room temperature to obtain EPIC. Examples of suitable CMR perovskites include  $\text{Pr}(1-x)\text{Ca}(x)\text{MnO}_3$ ,  $\text{La}(1-x)\text{Sr}(x)\text{MnO}_3$ , and  $\text{Nb}(1-x)\text{Ca}(x)\text{MnO}_3$ . Figure 2 is a block diagram showing an EPIC capacitor connected to a circuit that can vary the capacitance, measure the capacitance, and/or measure the resistance of the capacitor.

Derived from text

*Capacitance; Capacitors; Magnetoresistivity; Fabrication; Varactor Diodes*

**20090035882** Jet Propulsion Lab., California Inst. of Tech., Pasadena, CA, USA

**On the Divergence of the Velocity Vector in Real-Gas Flow**

Bellan, Josette; NASA Tech Briefs, October 2009; October 2009, pp. 26; In English; See also [20090035873](#)

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ONLINE: <http://hdl.handle.net/2060/20090035882>; <http://www.techbriefs.com/component/content/article/5789>

A theoretical study was performed addressing the degree of applicability or inapplicability, to a real gas, of the occasionally stated belief that for an ideal gas, incompressibility is synonymous with a zero or very low Mach number. The measure of compressibility used in this study is the magnitude of the divergence of the flow velocity vector  $[\nabla \cdot \mathbf{u}]$  (where  $\mathbf{u}$  is the flow velocity). The study involves a mathematical derivation that begins with the governing equations of flow and involves consideration of equations of state, thermodynamics, and fluxes of heat, mass, and the affected molecular species. The derivation leads to an equation for the volume integral of  $[\nabla \cdot \mathbf{u}]^2$  that indicates contributions of several thermodynamic, hydrodynamic, and species-flux effects to compressibility and reveals differences between real and ideal gases. An analysis of the equation leads to the conclusion that for a real gas, incompressibility is not synonymous with zero or very small Mach number. Therefore, it is further concluded, the contributions to compressibility revealed by the derived equation should be taken into account in simulations of real-gas flows.

Author

*Divergence; Flow Velocity; Gas Flow; Real Gases; Vectors (Mathematics)*

**20090035883** California Inst. of Tech., Pasadena, CA, USA

**Extending Newtonian Dynamics to Include Stochastic Processes**

Zak, Michail; NASA Tech Briefs, October 2009; October 2009, pp. 33; In English; See also [20090035873](#)

Report No.(s): NPO-45594; Copyright; Avail.: CASI: [A01](#), Hardcopy

ONLINE: <http://hdl.handle.net/2060/20090035883>; <http://www.techbriefs.com/component/content/article/5795>

A paper presents further results of continuing research reported in several previous NASA Tech Briefs articles, the two most recent being Stochastic Representations of Chaos Using Terminal Attractors (NPO-41519), [Vol. 30, No. 5 (May 2006), page 57] and Physical Principle for Generation of Randomness (NPO-43822) [Vol. 33, No. 5 (May 2009), page 56]. This research focuses upon a mathematical formalism for describing post-instability motions of a dynamical system characterized by exponential divergences of trajectories leading to chaos (including turbulence as a form of chaos). The formalism involves fictitious control forces that couple the equations of motion of the system with a Liouville equation that describes the evolution of the probability density of errors in initial conditions. These stabilizing forces create a powerful terminal attractor in probability space that corresponds to occurrence of a target trajectory with probability one. The effect in configuration space (ordinary three-dimensional space as commonly perceived) is to suppress exponential divergences of neighboring trajectories without affecting the target trajectory. As a result, the post-instability motion is represented by a set of functions describing the evolution of such statistical quantities as expectations and higher moments, and this representation is stable.

Author

*Stochastic Processes; Newton Methods; Trajectories; Liouville Equations; Divergence; Equations of Motion; Turbulence*

**20090035884** Illinois Univ., Urbana-Champaign, IL, USA

**Ultra-Large Solar Sail**

Burton, Rodney; Coverstone, Victoria; NASA Tech Briefs, October 2009; October 2009, pp. 19; In English; See also [20090035873](#)

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ONLINE: <http://hdl.handle.net/2060/20090035884>; <http://www.techbriefs.com/component/content/article/5778>

UltraSail is a next-generation ultra-large (km<sup>2</sup> class) sail system. Analysis of the launch, deployment, stabilization, and control of these sails shows that high-payload-mass fractions for interplanetary and deep-space missions are possible. UltraSail combines propulsion and control systems developed for formation-flying microsatellites with a solar sail architecture to achieve controllable sail areas approaching 1 km<sup>2</sup>. Electrically conductive CP-1 polyimide film results in sail subsystem area densities as low as 5 g/m<sup>2</sup>. UltraSail produces thrust levels many times those of ion thrusters used for comparable deep-space missions. The primary innovation involves the near-elimination of sail-supporting structures by attaching each blade tip to a formation-flying microsatellite, which deploys the sail and then articulates the sail to provide attitude control, including spin stabilization and precession of the spin axis. These microsatellite tips are controlled by microthrusters for sail-film deployment and mission operations. UltraSail also avoids the problems inherent in folded sail film, namely stressing, yielding, or perforating, by storing the film in a roll for launch and deployment. A 5-km long by 2 micrometer thick film roll on a mandrel with a 1 m circumference (32 cm diameter) has a stored thickness of 5 cm. A 5 m-long mandrel can store a film area of 25,000 m<sup>2</sup>, and a four-blade system has an area of 0.1 sq km.

Author

*Solar Sails; Propulsion System Performance; Deployment; Spin Stabilization; Propulsion System Configurations; Spacecraft Propulsion; Microrocket Engines; Attitude Control; Ion Engines*

**20090035885** NASA Johnson Space Center, Houston, TX, USA

**Using Ozone To Clean and Passivate Oxygen-Handling Hardware**

Torrance, Paul; Biesinger, Paul; NASA Tech Briefs, October 2009; October 2009, pp. 15; In English; See also [20090035873](#)

Report No.(s): MSC-23290-1; Copyright; Avail.: CASI: [A01](#), Hardcopy

ONLINE: <http://hdl.handle.net/2060/20090035885>; <http://www.techbriefs.com/component/content/article/5775>

A proposed method of cleaning, passivating, and verifying the cleanliness of oxygen-handling hardware would extend the established art of cleaning by use of ozone. As used here, 'cleaning' signifies ridding all exposed surfaces of combustible (in particular, carbon-based) contaminants. The method calls for exposing the surfaces of the hardware to ozone while monitoring the ozone effluent for carbon dioxide. The ozone would passivate the hardware while oxidizing carbon-based residues, converting the carbon in them to carbon dioxide. The exposure to ozone would be continued until no more carbon dioxide was detected, signifying that cleaning and passivation were complete.

Author

*Ozone; Contaminants; Passivity; Oxidation; Effluents; Cleaning; Carbon Dioxide; Residues*

**20090035886** California Inst. of Tech., Pasadena, CA, USA

**Guaranteeing Failsafe Operation of Extended-Scene Shack-Hartmann Wavefront Sensor Algorithm**

Sidick, Erikin; NASA Tech Briefs, October 2009; October 2009, pp. 6; In English; See also [20090035873](#)

Report No.(s): NPO-46582; Copyright; Avail.: CASI: A01, Hardcopy

ONLINE: <http://hdl.handle.net/2060/20090035886>; <http://www.techbriefs.com/component/content/article/5756>

A Shack-Hartmann sensor (SHS) is an optical instrument consisting of a lenslet array and a camera. It is widely used for wavefront sensing in optical testing and astronomical adaptive optics. The camera is placed at the focal point of the lenslet array and points at a star or any other point source. The image captured is an array of spot images. When the wavefront error at the lenslet array changes, the position of each spot measurably shifts from its original position. Determining the shifts of the spot images from their reference points shows the extent of the wavefront error. An adaptive cross-correlation (ACC) algorithm has been developed to use scenes as well as point sources for wavefront error detection. Qualifying an extended scene image is often not an easy task due to changing conditions in scene content, illumination level, background, Poisson noise, read-out noise, dark current, sampling format, and field of view. The proposed new technique based on ACC algorithm analyzes the effects of these conditions on the performance of the ACC algorithm and determines the viability of an extended scene image. If it is viable, then it can be used for error correction; if it is not, the image fails and will not be further processed. By potentially testing for a wide variety of conditions, the algorithm's accuracy can be virtually guaranteed. In a typical application, the ACC algorithm finds image shifts of more than 500 Shack-Hartmann camera sub-images relative to a reference sub-image or cell when performing one wavefront sensing iteration. In the proposed new technique, a pair of test and reference cells is selected from the same frame, preferably from two well-separated locations. The test cell is shifted by an integer number of pixels, say, for example, from  $m = -5$  to 5 along the x-direction by choosing a different area on the same sub-image, and the shifts are estimated using the ACC algorithm. The same is done in the y-direction. If the resulting shift estimate errors are less than a pre-determined threshold (e.g., 0.03 pixel), the image is accepted. Otherwise, it is rejected.

Author

*Cameras; Adaptive Optics; Point Sources; Field of View; Pixels; Error Analysis; Dark Current*

**20090035887** Analox Corp., USA

**Metal Standards for Waveguide Characterization of Materials**

Lambert, Kevin M.; Kory, Carol L.; NASA Tech Briefs, October 2009; October 2009, pp. 15-16; In English; See also [20090035873](#); Original contains color illustrations

Report No.(s): LEW-18137-1; Copyright; Avail.: CASI: A01, Hardcopy

ONLINE: <http://hdl.handle.net/2060/20090035887>; <http://www.techbriefs.com/component/content/article/5777>

Rectangular-waveguide inserts that are made of non-ferromagnetic metals and are sized and shaped to function as notch filters have been conceived as reference standards for use in the rectangular-waveguide method of characterizing materials with respect to such constitutive electromagnetic properties as permittivity and permeability. Such standards are needed for determining the accuracy of measurements used in the method, as described below. In this method, a specimen of a material to be characterized is cut to a prescribed size and shape and inserted in a rectangular-waveguide test fixture, wherein the specimen is irradiated with a known source signal and detectors are used to measure the signals reflected by, and transmitted through, the specimen. Scattering parameters [also known as 'S' parameters ( $S_{11}$ ,  $S_{12}$ ,  $S_{21}$ , and  $S_{22}$ )] are computed from ratios between the transmitted and reflected signals and the source signal. Then the permeability and permittivity of the specimen material are derived from the scattering parameters. Theoretically, the technique for calculating the permeability and permittivity from the scattering parameters is exact, but the accuracy of the results depends on the accuracy of the measurements from which the scattering parameters are obtained. To determine whether the measurements are accurate, it is necessary to perform comparable measurements on reference standards, which are essentially specimens that have known scattering parameters. To be most useful, reference standards should provide the full range of scattering-parameter values that can be obtained from material specimens. Specifically, measurements of the backscattering parameter ( $S_{11}$ ) from no reflection to total reflection and of the forward-transmission parameter ( $S_{21}$ ) from no transmission to total transmission are needed. A reference standard that functions as a notch (band-stop) filter can satisfy this need because as the signal frequency is varied across the frequency range for which the filter is designed, the scattering parameters vary over the ranges of values between the extremes of total reflection and total transmission. A notch-filter reference standard in the form of a rectangular-waveguide insert that has a size and shape similar to that of a material specimen is advantageous because the measurement configuration used for the reference standard can be the same as that for a material specimen. Typically a specimen is a block of material that fills a waveguide cross-section but occupies only a small fraction of the length of the waveguide. A reference standard of the present type (see figure) is a metal block that fills part of a waveguide cross section and contains a slot, the long dimension of which can be chosen to tailor the notch frequency to a desired value. The scattering parameters and notch

frequency can be estimated with high accuracy by use of commercially available electromagnetic-field-simulating software. The block can be fabricated to the requisite precision by wire electrical-discharge machining. In use, the accuracy of measurements is determined by comparison of (1) the scattering parameters calculated from the measurements with (2) the scattering parameters calculated by the aforementioned software.

Author

*Metals; Waveguides; Standards; Scattering; Permeability; Electromagnetic Properties; Backscattering; Electromagnetic Fields; Frequency Ranges; Rectangular Waveguides*

**20090035888** California Inst. of Tech., Pasadena, CA, USA

**Microfluidic Pumps Containing Teflon [Trademark] AF Diaphragms**

Willis, Peter; White, Victor; Grunthaner, Frank; Ikeda, Mike; Mathies, Richard A.; NASA Tech Briefs, October 2009; October 2009, pp. 21; In English; See also [20090035873](#)

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ONLINE: <http://hdl.handle.net/2060/20090035888>; <http://www.techbriefs.com/component/content/article/5783>

Microfluidic pumps and valves based on pneumatically actuated diaphragms made of Teflon AF polymers are being developed for incorporation into laboratory-on-a-chip devices that must perform well over temperature ranges wider than those of prior diaphragm-based microfluidic pumps and valves. Other potential applications include implanted biomedical microfluidic devices, wherein the biocompatibility of Teflon AF polymers would be highly advantageous. These pumps and valves have been demonstrated to function stably after cycling through temperatures from -125 to 120 C. These pumps and valves are intended to be successors to similar prior pumps and valves containing diaphragms made of polydimethylsiloxane (PDMS) [commonly known as silicone rubber]. The PDMS-containing valves are designed to function stably only within the temperature range from 5 to 80 C. Undesirably, PDMS membranes are somewhat porous and retain water. PDMS is especially unsuitable for use at temperatures below 0 C because the formation of ice crystals increases porosity and introduces microshear.

Author

*Bioinstrumentation; Methyl Polysiloxanes; Microfluidic Devices; Silicone Rubber; Fluoropolymers*

**20090035889** NASA, Washington, DC, USA

**Integrated Risk and Knowledge Management Program -- IRKM-P**

Lengyel, David M.; NASA Tech Briefs, October 2009; October 2009, pp. 29; In English; See also [20090035873](#)

Report No.(s): HQN-11315-1; Copyright; Avail.: CASI: [A01](#), Hardcopy

ONLINE: <http://hdl.handle.net/2060/20090035889>; <http://www.techbriefs.com/component/content/article/5790>

The NASA Exploration Systems Mission Directorate (ESMD) IRKM-P tightly couples risk management and knowledge management processes and tools to produce an effective 'modern' work environment. IRKM-P objectives include: (1) to learn lessons from past and current programs (Apollo, Space Shuttle, and the International Space Station); (2) to generate and share new engineering design, operations, and management best practices through preexisting Continuous Risk Management (CRM) procedures and knowledge-management practices; and (3) to infuse those lessons and best practices into current activities. The conceptual framework of the IRKM-P is based on the assumption that risks highlight potential knowledge gaps that might be mitigated through one or more knowledge management practices or artifacts. These same risks also serve as cues for collection of knowledge particularly, knowledge of technical or programmatic challenges that might recur.

Author

*Risk Management; Engineering Management; Space Shuttles; Procedures; Risk*

**20090035890** California Inst. of Tech., Pasadena, CA, USA

**Low-Noise MMIC Amplifiers for 120 to 180 GHz**

Pukala, David; Samoska, Lorene; Peralta, Alejandro; Bayuk, Brian; Grundbacher, Ron; Oliver, Patricia; Cavus, Abdullah; Liu, Po-Hsin; NASA Tech Briefs, October 2009; October 2009, pp. 14; In English; See also [20090035873](#); Original contains color illustrations

Report No.(s): NPO-42783; Copyright; Avail.: CASI: [A01](#), Hardcopy

ONLINE: <http://hdl.handle.net/2060/20090035890>; <http://www.techbriefs.com/component/content/article/5760>

Three-stage monolithic millimeter-wave integrated-circuit (MMIC) amplifiers capable of providing useful amounts of gain over the frequency range from 120 to 180 GHz have been developed as prototype low-noise amplifiers (LNAs) to be incorporated into instruments for sensing cosmic microwave background radiation. There are also potential uses for such



LNAs in electronic test equipment, passive millimeter-wave imaging systems, radar receivers, communication receivers, and systems for detecting hidden weapons. The main advantage afforded by these MMIC LNAs, relative to prior MMIC LNAs, is that their coverage of the 120-to-180-GHz frequency band makes them suitable for reuse in a wider variety of applications without need to redesign them. Each of these MMIC amplifiers includes InP transistors and coplanar waveguide circuitry on a 50- $\mu$ m-thick chip (see Figure 1). Coplanar waveguide transmission lines are used for both applying DC bias and matching of input and output impedances of each transistor stage. Via holes are incorporated between top and bottom ground planes to suppress propagation of electromagnetic modes in the substrate. On the basis of computational simulations, each of these amplifiers was expected to operate with a small-signal gain of 14 dB and a noise figure of 4.3 dB. At the time of writing this article, measurements of noise figures had not been reported, but on-chip measurements had shown gains approaching their simulated values (see Figure 2).

Author

*Cosmic Microwave Background Radiation; Microwave Circuits; Integrated Circuits; Low Noise; Microwave Amplifiers; Frequency Ranges; Transistors; Waveguides*

**20090035891** Defense Advanced Research Projects Agency, Arlington, VA, USA

#### **MMICs with Radial Probe Transitions to Waveguides**

Samoska, Lorene; Chattopadhyay, Goutam; Pukala, David; Soria, Mary; Fung, King Man; Gaier, Todd; Radisic, Vesna; Lai, Richard; NASA Tech Briefs, October 2009; October 2009, pp. 33; In English; See also [20090035873](#)

Report No.(s): NPO-45460; Copyright; Avail.: CASI: [A01](#), Hardcopy

ONLINE: <http://hdl.handle.net/2060/20090035891>; <http://www.techbriefs.com/component/content/article/5793>

A document presents an update on the innovation reported in Integrated Radial Probe Transition From MMIC to Waveguide (NPO-43957), NASA Tech Briefs Vol. 31, No. 5 (May 2007), page 38. To recapitulate: To enable operation or testing of a monolithic microwave integrated circuit (MMIC), it is necessary to mount the MMIC in a waveguide package that typically has cross-sectional waveguide dimensions of the order of a few hundred microns. A radial probe transition between an MMIC operating at 340 GHz and a waveguide had been designed (but not yet built and tested) to be fabricated as part of a monolithic unit that would include the MMIC. The radial probe could readily be integrated with an MMIC amplifier because the design provided for fabrication of the transition on a substrate of the same material (InP) and thickness (50  $\mu$ m) typical of substrates of MMICs that can operate above 300 GHz. As illustrated in the updated document by drawings, photographs, and plots of test data, the concept has now been realized by designing, fabricating, and testing several MMIC/radial-probe integrated-circuit chips and designing and fabricating a waveguide package to contain each chip.

Author

*Microwave Circuits; Integrated Circuits; Chips; Waveguides*

**20090035892** California Inst. of Tech., Pasadena, CA, USA

#### **Tests of Low-Noise MMIC Amplifier Module at 290 to 340 GHz**

Gaier, Todd; Samoska, Lorene; Fung, King Man; Deal, William; Mei, Xiaobing; Lai, Richard; NASA Tech Briefs, October 2009; October 2009, pp. 33; In English; See also [20090035873](#)

Report No.(s): NPO-45461; Copyright; Avail.: CASI: [A01](#), Hardcopy

ONLINE: <http://hdl.handle.net/2060/20090035892>; <http://www.techbriefs.com/component/content/article/5794>

A document presents data from tests of a low-noise amplifier module operating in the frequency range from 290 to 340 GHz said to be the highest-frequency low-noise, solid-state amplifier ever developed. The module comprised a three-stage monolithic microwave integrated circuit (MMIC) amplifier integrated with radial probe MMIC/waveguide transitions and contained in a compact waveguide package, all according to the concepts described in the immediately preceding article and in the referenced prior article, 'Integrated Radial Probe Transition From MMIC to Waveguide' (NPO-43957), NASA Tech Briefs Vol. 31, No. 5 (May 2007), page 38. The tests included measurements by the Y-factor method, in which noise figures are measured repeatedly with an input noise source alternating between an 'on' (hot-load) condition and an 'off' (cold-load) condition. (The Y factor is defined as the ratio between the 'on' and 'off' noise power levels.) The test results showed that, among other things, the module exhibited a minimum noise figure of about 8.7 dB at 325 GHz and that the gain at that frequency under the bias conditions that produced the minimum noise figure was between about 9 and 10 dB.

Author

*Frequency Ranges; Integrated Circuits; Noise Generators; Microwave Circuits; Low Noise; Noise Intensity; Waveguides*



**20090035893** NASA Johnson Space Center, Houston, TX, USA

**Improved Method of Design for Folding Inflatable Shells**

Johnson, Christopher J.; NASA Tech Briefs, October 2009; October 2009, pp. 17-18; In English; See also [20090035873](#); Original contains color illustrations

Report No.(s): MSC-24149-1; Copyright; Avail.: CASI: [A01](#), Hardcopy

ONLINE: <http://hdl.handle.net/2060/20090035893>; <http://www.techbriefs.com/component/content/article/5771>

An improved method of designing complexly shaped inflatable shells to be assembled from gores was conceived for original application to the inflatable outer shell of a developmental habitable spacecraft module having a cylindrical mid-length section with toroidal end caps. The method is also applicable to inflatable shells of various shapes for terrestrial use. The method addresses problems associated with the assembly, folding, transport, and deployment of inflatable shells that may comprise multiple layers and have complex shapes that can include such doubly curved surfaces as toroids and spheres. One particularly difficult problem is that of mathematically defining fold lines on a gore pattern in a double-curvature region. Moreover, because the fold lines in a double-curvature region tend to be curved, there is a practical problem of how to implement the folds. Another problem is that of modifying the basic gore shapes and sizes for the various layers so that when they are folded as part of the integral structure, they do not mechanically interfere with each other at the fold lines. Heretofore, it has been a common practice to design an inflatable shell to be assembled in the deployed configuration, without regard for the need to fold it into compact form. Typically, the result has been that folding has been a difficult, time-consuming process resulting in a An improved method of designing complexly shaped inflatable shells to be assembled from gores was conceived for original application to the inflatable outer shell of a developmental habitable spacecraft module having a cylindrical mid-length section with toroidal end caps. The method is also applicable to inflatable shells of various shapes for terrestrial use. The method addresses problems associated with the assembly, folding, transport, and deployment of inflatable shells that may comprise multiple layers and have complex shapes that can include such doubly curved surfaces as toroids and spheres. One particularly difficult problem is that of mathematically defining fold lines on a gore pattern in a double-curvature region. Moreover, because the fold lines in a double-curvature region tend to be curved, there is a practical problem of how to implement the folds. Another problem is that of modifying the basic gore shapes and sizes for the various layers so that when they are folded as part of the integral structure, they do not mechanically interfere with each other at the fold lines. Heretofore, it has been a common practice to design an inflatable shell to be assembled in the deployed configuration, without regard for the need to fold it into compact form. Typically, the result has been that folding has been a difficult, time-consuming process resulting in a poor stowed configuration.

Author

*Cylindrical Bodies; Folding; Spacecraft Modules; Deployment; Shapes; Inflatable Structures; Shells (Structural Forms)*

**20090035894** QorTek, Inc., Williamsport, PA, USA

**Pixelized Device Control Actuators for Large Adaptive Optics**

Knowles, Gareth J.; Bird, Ross W.; Shea, Brian; Chen, Peter; NASA Tech Briefs, October 2009; October 2009, pp. 6-7; In English; See also [20090035873](#)

Report No.(s): GSC-15666-1; Copyright; Avail.: CASI: [A01](#), Hardcopy

ONLINE: <http://hdl.handle.net/2060/20090035894>; <http://www.techbriefs.com/component/content/article/5759>

A fully integrated, compact, adaptive space optic mirror assembly has been developed, incorporating new advances in ultralight, high-performance composite mirrors. The composite mirrors use Q-switch matrix architecture-based pixelized control (PMN-PT) actuators, which achieve high-performance, large adaptive optic capability, while reducing the weight of present adaptive optic systems. The self-contained, fully assembled, 11x11x4-in. (approx.= 28x28x10-cm) unit integrates a very-high-performance 8-in. (approx.=20-cm) optic, and has 8-kHz true bandwidth. The assembled unit weighs less than 15 pounds (=6.8 kg), including all mechanical assemblies, power electronics, control electronics, drive electronics, face sheet, wiring, and cabling. It requires just three wires to be attached (power, ground, and signal) for full-function systems integration, and uses a steel-frame and epoxied electronics. The three main innovations are: 1. Ultralightweight composite optics: A new replication method for fabrication of very thin composite 20-cm-diameter laminate face sheets with good as-fabricated optical figure was developed. The approach is a new mandrel resin surface deposition onto previously fabricated thin composite laminates. 2. Matrix (regenerative) power topology: Waveform correction can be achieved across an entire face sheet at 6 kHz, even for large actuator counts. In practice, it was found to be better to develop a quadrant drive, that is, four quadrants of 169

actuators behind the face sheet. Each quadrant has a single, small, regenerative power supply driving all 169 actuators at 8 kHz in effective parallel. 3. Q-switch drive architecture: The Q-switch innovation is at the heart of the matrix architecture, and allows for a very fast current draw into a desired actuator element in 120 counts of a MHz clock without any actuator coupling.

Author

*Actuators; Adaptive Optics; Electronic Control; Pixels; Q Switched Lasers; Systems Integration; Waveforms; Bandwidth*

**20090035895** NASA Goddard Space Flight Center, Greenbelt, MD, USA

#### **T-Slide Linear Actuators**

Vranish, John; NASA Tech Briefs, October 2009; October 2009, pp. 7; In English; See also [20090035873](#); Original contains color illustrations

Report No.(s): GSC-15023-1; Copyright; Avail.: CASI: [A01](#), Hardcopy

ONLINE: <http://hdl.handle.net/2060/20090035895>; <http://www.techbriefs.com/component/content/article/5757>

T-slide linear actuators use gear bearing differential epicyclic transmissions (GBDETs) to directly drive a linear rack, which, in turn, performs the actuation. Conventional systems use a rotary power source in conjunction with a nut and screw to provide linear motion. Non-back-drive properties of GBDETs make the new actuator more direct and simpler. Versions of this approach will serve as a long-stroke, ultra-precision, position actuator for NASA science instruments, and as a rugged, linear actuator for NASA deployment duties. The T slide can operate effectively in the presence of side forces and torques. Versions of the actuator can perform ultra-precision positioning. A basic T-slide actuator is a long-stroke, rack-and-pinion linear actuator that, typically, consists of a T-slide, several idlers, a transmission to drive the slide (powered by an electric motor) and a housing that holds the entire assembly. The actuator is driven by gear action on its top surface, and is guided and constrained by gear-bearing idlers on its other two parallel surfaces. The geometry, implemented with gear-bearing technology, is particularly effective. An electronic motor operating through a GBDET can directly drive the T slide against large loads, as a rack and pinion linear actuator, with no break and no danger of back driving. The actuator drives the slide into position and stops. The slide holds position with power off and no brake, regardless of load. With the T slide configuration, this GBDET has an entire T-gear surface on which to operate. The GB idlers coupling the other two T slide parallel surfaces to their housing counterpart surfaces provide constraints in five degrees-of-freedom and rolling friction in the direction of actuation. Multiple GB idlers provide roller bearing strength sufficient to support efficient, rolling friction movement, even in the presence of large, resisting forces. T-slide actuators can be controlled using the combination of an off-the-shelf, electric servomotor, a motor angle resolution sensor (typically an encoder or resolver), and microprocessor-based intelligent software. In applications requiring precision positioning, it may be necessary to add strain gauges to the T-slide housing. Existing sensory- interactive motion control art will work for T slides. For open-loop positioning, a stepping motor emulation technique can be used.

Author

*Actuators; Bearings; Gears; Torque; Stepping Motors; Roller Bearings; Microprocessors; Interactive Control; Friction; Deployment*

**20090035896** California Inst. of Tech., Pasadena, CA, USA

#### **LDPC Codes with Minimum Distance Proportional to Block Size**

Divsalar, Dariush; Jones, Christopher; Dolinar, Samuel; Thorpe, Jeremy; NASA Tech Briefs, October 2009; October 2009, pp. 30-31; In English; See also [20090035873](#); Original contains color illustrations

Report No.(s): NPO-42063; Copyright; Avail.: CASI: [A01](#), Hardcopy

ONLINE: <http://hdl.handle.net/2060/20090035896>; <http://www.techbriefs.com/component/content/article/5792>

Low-density parity-check (LDPC) codes characterized by minimum Hamming distances proportional to block sizes have been demonstrated. Like the codes mentioned in the immediately preceding article, the present codes are error-correcting codes suitable for use in a variety of wireless data-communication systems that include noisy channels. The previously mentioned codes have low decoding thresholds and reasonably low error floors. However, the minimum Hamming distances of those codes do not grow linearly with code-block sizes. Codes that have this minimum-distance property exhibit very low error floors. Examples of such codes include regular LDPC codes with variable degrees of at least 3. Unfortunately, the decoding thresholds of regular LDPC codes are high. Hence, there is a need for LDPC codes characterized by both low decoding thresholds and, in order to obtain acceptably low error floors, minimum Hamming distances that are proportional to code-block sizes. The present codes were developed to satisfy this need. The minimum Hamming distances of the present codes have been shown, through consideration of ensemble-average weight enumerators, to be proportional to code block sizes. As in the cases of irregular ensembles, the properties of these codes are sensitive to the proportion of degree-2 variable nodes. A code having too few such nodes tends to have an iterative decoding threshold that is far from the capacity threshold.

A code having too many such nodes tends not to exhibit a minimum distance that is proportional to block size. Results of computational simulations have shown that the decoding thresholds of codes of the present type are lower than those of regular LDPC codes. Included in the simulations were a few examples from a family of codes characterized by rates ranging from low to high and by thresholds that adhere closely to their respective channel capacity thresholds; the simulation results from these examples showed that the codes in question have low error floors as well as low decoding thresholds. As an example, the illustration shows the protograph (which represents the blueprint for overall construction) of one proposed code family for code rates greater than or equal to 1.2. Any size LDPC code can be obtained by copying the protograph structure  $N$  times, then permuting the edges. The illustration also provides Field Programmable Gate Array (FPGA) hardware performance simulations for this code family. In addition, the illustration provides minimum signal-to-noise ratios ( $E_b/N_0$ ) in decibels (decoding thresholds) to achieve zero error rates as the code block size goes to infinity for various code rates. In comparison with the codes mentioned in the preceding article, these codes have slightly higher decoding thresholds.

Author

*Data Transmission; Telecommunication; Channel Capacity; Error Correcting Codes; Decoding*

**20090035897** Alliant Techsystems, Inc., USA

### **Two-Piece Screens for Decontaminating Granular Material**

Backes, Douglas; Poulter, Clay; Godfrey, Max; Dutton, Melinda; Tolman, Dennis; NASA Tech Briefs, October 2009; October 2009, pp. 16; In English; See also [20090035873](#)

Report No.(s): MFS-32496-1; Copyright; Avail.: CASI: A01, Hardcopy

ONLINE: <http://hdl.handle.net/2060/20090035897>; <http://www.techbriefs.com/component/content/article/5776>

Two-piece screens have been designed specifically for use in filtering a granular material to remove contaminant particles that are significantly wider or longer than are the desired granules. In the original application for which the twopiece screens were conceived, the granular material is ammonium perchlorate and the contaminant particles tend to be wires and other relatively long, rigid strands. The basic design of the twopiece screens can be adapted to other granular materials and contaminants by modifying critical dimensions to accommodate different grain and contaminant- particle sizes. A two-piece screen of this type consists mainly of (1) a top flat plate perforated with circular holes arranged in a hexagonal pattern and (2) a bottom plate that is also perforated with circular holes (but not in a pure hexagonal pattern) and is folded into an accordion structure. Fabrication of the bottom plate begins with drilling circular holes into a flat plate in a hexagonal pattern that is interrupted, at regular intervals, by parallel gaps. The plate is then folded into the accordion structure along the gaps. Because the folds are along the gaps, there are no holes at the peaks and valleys of the accordion screen. The top flat plate and the bottom accordion plate are secured within a metal frame. The resulting two-piece screen is placed at the bottom opening of a feed hopper containing the granular material to be filtered. Tests have shown that such long, rigid contaminant strands as wires readily can pass through a filter consisting of the flat screen alone and that the addition of the accordion screen below the flat screen greatly increases the effectiveness of removal of wires and other contaminant strands. Part of the reason for increased effectiveness is in the presentation of the contaminant to the filter surface. Testing has shown that wire type contamination will readily align itself parallel to the material direction flow. Since this direction of flow is nearly always perpendicular to the filter surface holes, the contamination is automatically aligned to pass through. The two-filter configuration reduces the likelihood that a given contaminant strand will be aligned with the flow of material by eliminating the perpendicular presentation angle. Thus, for wires of a certain diameter, a two-piece screen is 20 percent more effective than is the corresponding flat perforated plate alone, even if the holes in the flat plate are narrower. An accordion screen alone is similarly effective in catching contaminants, but lumps of agglomerated granules of the desired material often collect in the valleys and clog the screen. The addition of a flat screen above the accordion screen prevents clogging of the accordion screen. Flat wire screens have often been used to remove contaminants from granular materials, and are about as effective as are the corresponding perforated flat plates used alone.

Author

*Granular Materials; Decontamination; Perforated Plates; Frames; Ammonium Perchlorates*

**20090035898** Jet Propulsion Lab., California Inst. of Tech., Pasadena, CA, USA

### **Instruments for Imaging from Far to Near**

Mungas, Greg; Boynton, John; Sepulveda, Cesar; NASA Tech Briefs, October 2009; October 2009; 1 pp.; See also [20090035873](#); Original contains color illustrations

Report No.(s): NPO-44780; Copyright; Avail.: CASI: , Hardcopy

ONLINE: <http://hdl.handle.net/2060/20090035898>; <http://www.techbriefs.com/component/content/article/5797>

The acronym CHAMP (signifying camera, hand lens, and microscope ) denotes any of several proposed optoelectronic

instruments that would be capable of color imaging at working distances that could be varied continuously through a range from infinity down to several millimeters. As in any optical instrument, the magnification, depth of field, and spatial resolution would vary with the working distance. For example, in one CHAMP version, at a working distance of 2.5 m, the instrument would function as an electronic camera with a magnification of 1/100, whereas at a working distance of 7 mm, the instrument would function as a microscope/electronic camera with a magnification of 4.4. Moreover, as described below, when operating at or near the shortest-working-distance/highest-magnification combination, a CHAMP could be made to perform one or more spectral imaging functions. CHAMPs were originally intended to be used in robotic geological exploration of the Moon and Mars. The CHAMP concept also has potential for diverse terrestrial applications that could include remotely controlled or robotic geological exploration, prospecting, field microbiology, environmental surveying, and assembly-line inspection. A CHAMP (see figure) would include two lens cells: (1) a distal cell corresponding to the objective lens assembly of a conventional telescope or microscope and (2) a proximal cell that would contain the focusing camera lens assembly and the camera electronic image-detector chip, which would be of the active-pixel-sensor (APS) type. The distal lens cell would face outward from a housing, while the proximal lens cell would lie in a clean environment inside the housing. The proximal lens cell would contain a beam splitter that would enable simultaneous use of the imaging optics (that is, proximal and distal lens assemblies) for imaging and illumination of the field of view. The APS chip would be mounted on a focal plane on a side face of the beam splitter, while light for illuminating the field of view would enter the imaging optics via the end face of the beam splitter. The proximal lens cell would be mounted on a sled that could be translated along the optical axis for focus adjustment. The position of the CHAMP would initially be chosen at the desired working distance of the distal lens from (corresponding to an approximate desired magnification of) an object to be examined. During subsequent operation, the working distance would ordinarily remain fixed at the chosen value and the position of the proximal lens cell within the instrument would be adjusted for focus as needed.

Author

*Imaging Techniques; Spatial Resolution; Optical Thickness; Telescopes; Field of View; Lenses; Magnification*

**20090035899** California Inst. of Tech., Pasadena, CA, USA

### **Three MMIC Amplifiers for the 120-to-200 GHz Frequency Band**

Samoska, Lorene; Schmitz, Adele; NASA Tech Briefs, October 2009; October 2009, pp. 13-14; In English; See also [20090035873](#); Original contains color illustrations

Report No.(s): NPO-42846; Copyright; Avail.: CASI: [A01](#), Hardcopy

ONLINE: <http://hdl.handle.net/2060/20090035899>; <http://www.techbriefs.com/component/content/article/5761>

Closely following the development reported in the immediately preceding article, three new monolithic microwave integrated circuit (MMIC) amplifiers that would operate in the 120-to-200-GHz frequency band have been designed and are under construction at this writing. The active devices in these amplifiers are InP high-electron-mobility transistors (HEMTs). These amplifiers (see figure) are denoted the LSLNA150, the LSA200, and the LSA185, respectively. Like the amplifiers reported in the immediately preceding article, the LSLNA150 (1) is intended to be a prototype of low-noise amplifiers (LNAs) to be incorporated into spaceborne instruments for sensing cosmic microwave background radiation and (2) has potential for terrestrial use in electronic test equipment, passive millimeter-wave imaging systems, radar receivers, communication receivers, and systems for detecting hidden weapons. The HEMTs in this amplifier were fabricated according to 0.08-  $\mu$ m design rules of a commercial product line of InP HEMT MMICs at HRL Laboratories, LLC, with a gate geometry of 2 fingers, each 15  $\mu$ m wide. On the basis of computational simulations, this amplifier is designed to afford at least 15 dB of gain, with a noise figure of no more than about 6 dB, at frequencies from 120 to 160 GHz. The measured results of the amplifier are shown next to the chip photo, with a gain of 16 dB at 150 GHz. Noise figure work is ongoing. The LSA200 and the LSA185 are intended to be prototypes of transmitting power amplifiers for use at frequencies between about 180 and about 200 GHz. These amplifiers have also been fabricated according to rules of the aforesaid commercial product line of InP HEMT MMICs, except that the HEMTs in these amplifiers are characterized by a gate geometry of 4 fingers, each 37  $\mu$ m wide. The measured peak performance of the LSA200 is characterized by a gain of about 1.4 dB at a frequency of 190 GHz; the measured peak performance of the LSA185 is characterized by a gain of about 2.7 dB at a frequency of 181 GHz. The measured gain results of each chip are shown next to their respective photos.

Author

*High Electron Mobility Transistors; Microwave Circuits; Integrated Circuits; Cosmic Microwave Background Radiation; Millimeter Waves; Electronic Equipment*



**20090035900** California Inst. of Tech., Pasadena, CA, USA

**Constructing LDPC Codes from Loop-Free Encoding Modules**

Divsalar, Dariush; Dolinar, Samuel; Jones, Christopher; Thorpe, Jeremy; Andrews, Kenneth; NASA Tech Briefs, October 2009; October 2009, pp. 31; In English; See also [20090035873](#); Original contains color illustrations

Report No.(s): NPO-42042; Copyright; Avail.: CASI: [A01](#), Hardcopy

ONLINE: <http://hdl.handle.net/2060/20090035900>; <http://www.techbriefs.com/component/content/article/5791>

A method of constructing certain low-density parity-check (LDPC) codes by use of relatively simple loop-free coding modules has been developed. The subclasses of LDPC codes to which the method applies includes accumulate-repeat-accumulate (ARA) codes, accumulate-repeat-check-accumulate codes, and the codes described in Accumulate-Repeat-Accumulate-Accumulate Codes (NPO-41305), NASA Tech Briefs, Vol. 31, No. 9 (September 2007), page 90. All of the affected codes can be characterized as serial/parallel (hybrid) concatenations of such relatively simple modules as accumulators, repetition codes, differentiators, and punctured single-parity check codes. These are error-correcting codes suitable for use in a variety of wireless data-communication systems that include noisy channels. These codes can also be characterized as hybrid turbolike codes that have projected graph or protograph representations (for example see figure); these characteristics make it possible to design high-speed iterative decoders that utilize belief-propagation algorithms. The present method comprises two related submethods for constructing LDPC codes from simple loop-free modules with circulant permutations. The first submethod is an iterative encoding method based on the erasure-decoding algorithm. The computations required by this method are well organized because they involve a parity-check matrix having a block-circulant structure. The second submethod involves the use of block-circulant generator matrices. The encoders of this method are very similar to those of recursive convolutional codes. Some encoders according to this second submethod have been implemented in a small field-programmable gate array that operates at a speed of 100 megasymbols per second. By use of density evolution (a computational- simulation technique for analyzing performances of LDPC codes), it has been shown through some examples that as the block size goes to infinity, low iterative decoding thresholds close to channel capacity limits can be achieved for the codes of the type in question having low maximum variable node degrees. The decoding thresholds in these examples are lower than those of the best-known unstructured irregular LDPC codes constrained to have the same maximum node degrees. Furthermore, the present method enables the construction of codes of any desired rate with thresholds that stay uniformly close to their respective channel capacity thresholds.

Author

*Channel Capacity; Parity; Error Correcting Codes; Field-Programmable Gate Arrays; Accumulators; Data Transmission*

**20090035901** Anasphere, Inc., Bozeman, MT, USA

**Cloud Water Content Sensor for Sounding Balloons and Small UAVs**

Bognar, John A.; NASA Tech Briefs, October 2009; October 2009, pp. 6; In English; See also [20090035873](#)

Report No.(s): GSC-15638-1; Copyright; Avail.: CASI: [A01](#), Hardcopy

ONLINE: <http://hdl.handle.net/2060/20090035901>; <http://www.techbriefs.com/component/content/article/5758>

A lightweight, battery-powered sensor was developed for measuring cloud water content, which is the amount of liquid or solid water present in a cloud, generally expressed as grams of water per cubic meter. This sensor has near-zero power consumption and can be flown on standard sounding balloons and small, unmanned aerial vehicles (UAVs). The amount of solid or liquid water is important to the study of atmospheric processes and behavior. Previous sensing techniques relied on strongly heating the incoming air, which requires a major energy input that cannot be achieved on sounding balloons or small UAVs.

Author

*Pilotless Aircraft; Balloons; Energy Consumption; Moisture Content; Water; Detection*

**20090035902** Jet Propulsion Lab., California Inst. of Tech., Pasadena, CA, USA

**Progress Toward a Compact, Highly Stable Ion Clock**

Prestage, John; Chung, Sang; NASA Tech Briefs, October 2009; October 2009, pp. 26; In English; See also [20090035873](#)

Report No.(s): NPO-44139; Copyright; Avail.: CASI: [A01](#), Hardcopy

ONLINE: <http://hdl.handle.net/2060/20090035902>; <http://www.techbriefs.com/component/content/article/5787>

There was an update on the subject of two previous NASA Tech Briefs articles: Compact, Highly Stable Ion Clock (NPO-43075), Vol. 32, No. 5 (May 2008), page 63; and Neon as a Buffer Gas for a Mercury-Ion Clock (NPO-42919), Vol. 32, No. 7 (July 2008), page 62. To recapitulate: A developmental miniature mercury-ion clock has stability comparable to that of a hydrogen-maser clock. The ion-handling components are housed in a sealed vacuum tube, wherein a getter pump maintains the partial vacuum, and the evacuated tube is backfilled with mercury vapor in a neon buffer gas. There was progress



in the development of the clock, with emphasis on the design, fabrication, pump-down, and bake-out of the vacuum tube (based on established practice in the travelingwave- tube-amplifier industry) and the ability of the tube to retain a vacuum after a year of operation. Other developments include some aspects of the operation of mercury-vapor source (a small appendage oven containing HgO) so as to maintain the optimum low concentration of mercury vapor, and further efforts to miniaturize the vacuum and optical subsystems to fit within a volume of 2 L.

Author

*Fabrication; Miniaturization; Metal Ions; Mercury (Metal); Clocks*

**20090035905** California Inst. of Tech., Pasadena, CA, USA

**System for Automated Calibration of Vector Modulators**

Lux, James; Boas, Amy; Li, Samuel; NASA Tech Briefs, October 2009; October 2009, pp. 11-12; In English; See also [20090035873](#); Original contains color illustrations

Report No.(s): NPO-44518; Copyright; Avail.: CASI: [A01](#), Hardcopy

ONLINE: <http://hdl.handle.net/2060/20090035905>; <http://www.techbriefs.com/component/content/article/5774>

Vector modulators are used to impose baseband modulation on RF signals, but non-ideal behavior limits the overall performance. The non-ideal behavior of the vector modulator is compensated using data collected with the use of an automated test system driven by a LabVIEW program that systematically applies thousands of control-signal values to the device under test and collects RF measurement data. The technology innovation automates several steps in the process. First, an automated test system, using computer controlled digital-to-analog converters (DACs) and a computer-controlled vector network analyzer (VNA) systematically can apply different I and Q signals (which represent the complex number by which the RF signal is multiplied) to the vector modulator under test (VMUT), while measuring the RF performance specifically, gain and phase. The automated test system uses the LabVIEW software to control the test equipment, collect the data, and write it to a file. The input to the Lab - VIEW program is either user-input for systematic variation, or is provided in a file containing specific test values that should be fed to the VMUT. The output file contains both the control signals and the measured data. The second step is to post-process the file to determine the correction functions as needed. The result of the entire process is a tabular representation, which allows translation of a desired I/Q value to the required analog control signals to produce a particular RF behavior. In some applications, corrected performance is needed only for a limited range. If the vector modulator is being used as a phase shifter, there is only a need to correct I and Q values that represent points on a circle, not the entire plane. This innovation has been used to calibrate 2-GHz MMIC (monolithic microwave integrated circuit) vector modulators in the High EIRP Cluster Array project (EIRP is high effective isotropic radiated power). These calibrations were then used to create correction tables to allow the commanding of the phase shift in each of four channels used as a phased array for beam steering of a Ka-band (32-GHz) signal. The system also was the basis of a breadboard electronic beam steering system. In this breadboard, the goal was not to make systematic measurements of the properties of a vector modulator, but to drive the breadboard with a series of test patterns varying in phase and amplitude. This is essentially the same calibration process, but with the difference that the data collection process is oriented toward collecting breadboard performance, rather than the measurement of output from a network analyzer.

Author

*Calibrating; Modulators; Systems Engineering; Integrated Circuits; Algorithms; Network Analysis; Automatic Control*

**20090035906** California Inst. of Tech., Pasadena, CA, USA

**Complementary Paired G4FETs as Voltage-Controlled NDR Device**

Mojarradi, Mohammad; Chen, Suheng; Blalock, Ben; Britton, Chuck; Prothro, Ben; Vandersand, James; Schrimph, Ron; Cristoloveanu, Sorin; Akavardar, Kerem; Gentil, P.; NASA Tech Briefs, October 2009; October 2009, pp. 12-13; In English; See also [20090035873](#); Original contains color illustrations

Report No.(s): NPO-43929; Copyright; Avail.: CASI: [A01](#), Hardcopy

ONLINE: <http://hdl.handle.net/2060/20090035906>; <http://www.techbriefs.com/component/content/article/5768>

It is possible to synthesize a voltage-controlled negative-differential-resistance (NDR) device or circuit by use of a pair of complementary G4FETs (four-gate field-effect transistors). [For more information about G4FETs, please see the immediately preceding article]. As shown in Figure 1, the present voltage-controlled NDR device or circuit is an updated version of a prior NDR device or circuit, known as a lambda diode, that contains a pair of complementary junction field-effect transistors (JFETs). (The lambda diode is so named because its current-versus- voltage plot bears some resemblance to an upper-case lambda.) The present version can be derived from the prior version by substituting G4FETs for the JFETs and connecting both JFET gates of each G4FET together. The front gate terminals of the G4FETs constitute additional terminals (that is, terminals not available in the older JFET version) to which one can apply control voltages VN and VP. Circuits in

which NDR devices have been used include (1) Schmitt triggers and (2) oscillators containing inductance/ capacitance (LC) resonant circuits. Figure 2 depicts such circuits containing G4FET NDR devices like that of Figure 1. In the Schmitt trigger shown here, the G4FET NDR is loaded with an ordinary inversion-mode, p-channel, metal oxide/semiconductor field-effect transistor (inversion-mode PMOSFET), the VN terminal of the G4FET NDR device is used as an input terminal, and the input terminals of the PMOSFET and the G4FET NDR device are connected. VP can be used as an extra control voltage (that is, a control voltage not available in a typical prior Schmitt trigger) for adjusting the pinch-off voltage of the p-channel G4FET and thereby adjusting the trigger-voltage window. In the oscillator, a G4FET NDR device is loaded with a conventional LC tank circuit. As in other LC NDR oscillators, oscillation occurs because the NDR counteracts the resistance in the tank circuit. The advantage of this G4FET-NDR LC oscillator over a conventional LC NDR oscillator is that one can apply a time-varying signal to one of the extra control input terminals (VN or VP) to modulate the conductance of the NDR device and thereby amplitude-modulate the output signal.

Derived from text

*Electric Potential; Field Effect Transistors; Voltage Regulators; Negative Resistance Devices; Capacitance*

## 88

### SPACE SCIENCES (GENERAL)

Includes general research topics related to the natural space sciences. For specific topics in space sciences see *categories 89 through 93*.

**20090035627** NASA Johnson Space Center, Houston, TX, USA

#### **Sample Return: What Happens to the Samples on Earth?**

McNamara, Karen; [2010]; 1 pp.; In English; Earth and Space Conference for 2010, 14-18 Mar. 2010, Honolulu, HI, USA  
Report No.(s): JSC-CN-18955; No Copyright; Avail.: Other Sources; Abstract Only

As space agencies throughout the world turn their attention toward human exploration of the Moon, Mars, and the solar system beyond, there has been an increase in the number of robotic sample return missions proposed as precursors to these human endeavors. In reality, however, we, as a global community, have very little experience with robotic sample return missions: 3 of the Russian Luna Missions successfully returned lunar material in the 1970s; 28 years later, in 2004, NASA's Genesis Mission returned material from the solar wind; and in 2006, NASA's Stardust Mission returned material from the Comet Wild2. [Note: The Japanese Hyabusa mission continues in space with the hope of returning material from the asteroid 25143 Itokawa.] We launch many spacecraft to LEO and return them to Earth. We also launch spacecraft beyond LEO to explore the planets, our solar system, and beyond. Some even land on these bodies. But these do not return. So as we begin to contemplate the sample return missions of the future, some common questions arise: 'What really happens when the capsule returns?' 'Where does it land?' 'Who retrieves it and just how do they do that?' 'Where does it go after that?' 'How do the scientists get the samples?' 'Do they keep them?' 'Who is in charge?' The questions are nearly endless. The goal of this paper/presentation is to uncover many of the mysteries of the post-return phase of a mission - from the time the return body enters the atmosphere until the mission ends and the samples become part of a long term collection. The discussion will be based largely on the author's own experience with both the Genesis and Stardust missions. Of course, these two missions have a great deal in common, being funded by the same NASA Program (Discovery) and having similar team composition. The intent, however, is to use these missions as examples in order to highlight the general requirements and the challenges in defining and meeting those requirements for the final phase of sample return missions. The choices made by the Genesis and Stardust teams regarding recovery and sample handling will be discussed. These will be compared with the handling of returned lunar samples and the proposed handling of the Hyabusa samples as well. Finally, though none of these recent missions have been restricted within NASA's Planetary Protection Protocol, this is likely to change as missions venture farther from Earth. The implementation of Planetary Protection requirements will vary significantly based on mission scenario, however some of the potential implications of restricted Earth return will be considered.

Author

*Low Earth Orbits; Sample Return Missions; Lunar Geology; Lunar Rocks; Genesis Mission; Stardust Mission; Planetary Protection; Robotics; Asteroids; Comets*

**20090035724** Naval Observatory, Washington, DC USA

**Speckle Interferometry at Mount Wilson Observatory: Observations Obtained in 2006-2007 and 35 New Orbits**

Hartkopf, William I.; Mason, Brian D.; The Astronomical Journal; May 2009; Volume 138, pp. 813-826; In English

Contract(s)/Grant(s): NNH06AD70I

Report No.(s): AD-A505053; No Copyright; Avail.: Other Sources

ONLINE: <http://dx.doi.org/10.1088/0004-6256/138/3/813>

Results are presented for 607 speckle interferometric observations of double stars, as well as 222 measures of single stars or unresolved pairs. All data were obtained in 2006 and 2007 at the Mount Wilson Observatory, using the 2.5 m Hooker telescope. Separations range from 0.06 to 6.31, with a median of 0.34. These three observing runs concentrated on binaries in need of confirmation (mainly Hipparcos and Tycho pairs), as well as systems in need of improved orbital elements. New orbital solutions have been determined for 35 systems as a result.

Author

*Orbits; Speckle Interferometry; Supports*

**20090035733** Jet Propulsion Lab., California Inst. of Tech., Pasadena, CA, USA

**Europa Explorer: 2008 Study Approach**

Pappalardo, Robert; Clark, Karla; August 29, 2007; 28 pp.; In English; Europa SDT Meeting, 27 Mar. 2008, Pasadena, CA, USA; Original contains color and black and white illustrations

Contract(s)/Grant(s): NMO710851

Report No.(s): JPL D-38502; Copyright; Avail.: Other Sources

ONLINE: <http://hdl.handle.net/2014/41392>

This viewgraph presentation reviews the Europa Explorer. The contents include: 1) Science and TMC Panel Comments; 2) 2008 Study Ground Rules; and 3) Approach for Meeting New Ground Rules.

CASI

*Europa; Geophysics; Space Missions; Systems Engineering*

**20090035735** Jet Propulsion Lab., California Inst. of Tech., Pasadena, CA, USA

**Space Exploration Communications and Navigation Status Panel**

Clare, Loren; March 6, 2008; 8 pp.; In English; IEEE Aerospace Conference, 6 Mar. 2008, Big Sky, MT, USA; Original contains color illustrations; Copyright; Avail.: Other Sources

ONLINE: <http://hdl.handle.net/2014/41394>

The contents include: 1) Introductions; 2) Top-level status; 3) Topic briefings by panel members; and 4) Open discussion.

CASI

*Navigation; Space Exploration; Space Communication; NASA Space Programs*

**20090035821** NASA Glenn Research Center, Cleveland, OH, USA

**Achieving a Prioritized Research and Technology Development Portfolio for the Dust Management Project**

Hyatt, Mark J.; Abel, Phillip; Delaune, Paul; Fishman, Julianna; Kohli, Rajiv; March 07, 2009; 12 pp.; In English; 2009 IEEE Aerospace Conference, 7-14 Mar. 2009, Big Sky, MT, USA

Report No.(s): ARC-E-DAA-TN216; Copyright; Avail.: CASI: A03, Hardcopy

ONLINE: <http://hdl.handle.net/2060/20090035821>

Mission architectures for human exploration of the lunar surface continue to advance as well as the definitions of capability needs, best practices and engineering design to mitigate the impact of lunar dust on exposed systems. The NASA DMP has been established as the agency focal point for dust characterization, technology, and simulant development. As described in this paper, the DMP has defined a process for selecting and justifying its R&T portfolio. The technology prioritization process, which is based on a ranking system according to weighted criteria, has been successfully applied to the current DMP dust mitigation technology portfolio. Several key findings emerged from this assessment. Within the dust removal and cleaning technologies group, there are critical technical challenges that must be overcome for these technologies to be implemented for lunar applications. For example, an in-situ source of CO<sub>2</sub> on the moon is essential to the CO<sub>2</sub> shower technology. Also, significant development effort is required to achieve technology readiness level TRL 6 for the electrostatic cleaning system for removal of particles smaller than 50 pm. The baseline materials related technologies require considerable development just to achieve TRL 6. It is also a nontrivial effort to integrate the materials in hardware for lunar application. At present, there are no terrestrial applications that are readily adaptable to lunar surface applications nor are there any obvious

leading candidates. The unique requirements of dust sealing systems for lunar applications suggest an extensive development effort will be necessary to mature dust sealing systems to TRL 6 and beyond. As discussed here, several alternate materials and technologies have achieved high levels of maturity for terrestrial applications and warrant due diligence in ongoing assessment of the technology portfolio. The present assessment is the initial step in an ongoing effort to continually evaluate the DMP technology portfolio and external non-NASA relevant technology developments efforts to maintain an optimal investment profile. At the same time, there is an ongoing review of agency-wide dust-related R&T activities. The results of these ongoing assessments will be reported in future publications.

Author

*Lunar Dust; Lunar Surface; Electrostatics; Carbon Dioxide; Cleaning*

**20090035826** SGT, Inc., Moffett Field, CA, USA

**Peer-to-Peer Planning for Space Mission Control**

Barreiro, Javier; Jones, Grailing, Jr.; Schaffer, Steve; March 07, 2009; 15 pp.; In English; IEEE Aerospace Conference, 7-14 Mar. 2009, Big Sky, MT, USA; Original contains black and white illustrations

Contract(s)/Grant(s): NNA04AA18B

Report No.(s): ARC-E-DAA-TN330; Copyright; Avail.: CASI: [A03](#), Hardcopy

ONLINE: <http://hdl.handle.net/2060/20090035826>

Planning and scheduling for space operations entails the development of applications that embed intimate domain knowledge of distinct areas of mission control, while allowing for significant collaboration among them. The separation is useful because of differences in the planning problem, solution methods, and frequencies of replanning that arise in the different disciplines. For example, planning the activities of human spaceflight crews requires some reasoning about all spacecraft resources at timescales of minutes or seconds, and is subject to considerable volatility. Detailed power planning requires managing the complex interplay of power consumption and production, involves very different classes of constraints and preferences, but once plans are generated they are relatively stable.

Author

*Mission Planning; Space Missions; Space Flight; Energy Consumption; Scheduling*

**20090036306** NASA Marshall Space Flight Center, Huntsville, AL, USA

**Powering the Future of Science and Exploration**

Miley, Steven C.; August 06, 2009; 14 pp.; In English; Powering the Future of Science and Exploration, 6 Aug. 2009, Huntsville, AL, USA; Original contains color illustrations

Report No.(s): M09-0681; No Copyright; Avail.: CASI: [A03](#), Hardcopy

ONLINE: <http://hdl.handle.net/2060/20090036306>

This viewgraph presentation reviews NASA's future of science and space exploration. The topics include: 1) NASA's strategic goals; 2) NASA around the Country; 3) Marshall's History; 4) Marshall's Missions; 5) Marshall Statistics: From Exploration to Opportunity; 6) Propulsion and Transportation Systems; 7) Life Support systems; 8) Earth Science; 9) Space Science; 10) NASA Innovation Creates New Jobs, Markets, and Technologies; 11) NASA Inspires Future Generations of Explorers; and 12) Why Explore?

CASI

*Space Exploration; Aerospace Sciences; NASA Space Programs; Spacecraft Design; Space Missions; Earth Sciences*

## 89

### ASTRONOMY

Includes observations of celestial bodies; astronomical instruments and techniques; radio, gamma-ray, x-ray, ultraviolet, and infrared astronomy; and astrometry.

**20090034944** NASA Goddard Space Flight Center, Greenbelt, MD, USA

**Modeling of the 22 July 2009 Storm**

Fok, Mei-Ching; Buzulukova, Natalia; [2009]; 1 pp.; In English; American Geophysical Union Conference, 14-19 Dec. 2009, San Francisco, CA, USA; No Copyright; Avail.: Other Sources; Abstract Only

The magnetic storm on 22 July 2009 is the greatest storm observed since the summer of 2008 when TWINS began its stereo imaging of the magnetosphere. On 22 July 2009, the Dst dropped to nearly -80 nT at 07:00 and 10:00 UT. During the main phase and at the peak of the storm, TWINS 1 and 2 were near apogee and moving from pre-dawn to post-dawn local

time. The energetic neutral atom (ENA) Imagers on the 2 spacecraft captured the storm intensification and the formation of the partial ring current. The development of this storm has been simulated using the Comprehensive Ring Current Model (CRCM) to understand and interpret the observed signatures. The CRCM reproduced the double-dip in the Dst index and the simulated ENA flux intensities agree very well with the TWINS images. However, the peak of ion flux predicted by the model is always eastward of the observed maximum by TWINS. This discrepancy posts a challenge to reexamine the physical models employed in the CRCM.

Author

*Environment Simulation; Magnetic Storms; Imaging Spectrometers; Astronomical Models; Flux Density*

**20090035624** NASA Goddard Space Flight Center, Greenbelt, MD, USA

**Extrasolar Planetary Imaging Coronagraph (EPIC)**

Clampin, Mark; September 13, 2009; 1 pp.; In English; Pathways Toward Habitable Planets, 13-19 Sep. 2009, Barcelona, Spain; No Copyright; Avail.: Other Sources; Abstract Only

EPIC is a NASA mission being studied to detect and characterize Jovian and superEarth planets, and, the dust/debris disks surrounding the parent star. It will be launched into a heliocentric Earth trailing orbit and operate for 5 years. EPIC would operate over the wavelength range of 480 - 960 nm with spectral resolutions of  $R < 50$  and employs a visible nulling coronagraph (VNC) to suppress the starlight, yielding contrast ratios of greater than 9 orders of magnitude. We will discuss the science mission, and its role in the search for habitable planets.

Author

*Solar Orbits; Gas Giant Planets; Coronagraphs; Extrasolar Planets; Imaging Techniques; Habitability*

**20090035776** Gemini Observatory, Hilo, HI, USA

**Gemini Focus: Newsletter of the Gemini Observatory**

Michaud, Peter, Editor; Fisher, R. Scott, Editor; Petersen, Carolyn Collins, Editor; June 2009; 84 pp.; In English; See also 20090035777 - 20090035785; Original contains color illustrations; Copyright; Avail.: Other Sources

Topics covered include: What Does 2009 Teach Us?; Creating a More Perfect Machine; When Gemini Came Into Focus: The November 29, 1990, Oxford Science Meeting; An Exoplanet Family Portrait; Unveiling Galaxy Bulge Formation with Long-slit Spectroscopy; Feeding Versus Feedback in NGC 4151; Recent Science Highlights; The Quest for Other Worlds: The Gemini NICI Planet-finding Campaign; Instrumentation Update.

Author

*Galactic Evolution; Observatories; Extrasolar Planets; Spectroscopy*

**20090035777** Universidade Federal do Rio Grande do Sul, Porto Alegre, Brazil

**Feeding Versus Feedback in NGC 4151**

Bergmann, Thaisa Storchi; Gemini Focus: Newsletter of the Gemini Observatory; June 2009, pp. 51-54; In English; See also 20090035776; Copyright; Avail.: Other Sources

NGC 4151 is the nearest bright Seyfert I galaxy to Earth and thus harbors one of the best-studied active galactic nuclei (AGN). At a distance of only about 13.3 Mpc (43.3 million light-years), the scale at the galaxy is 65 parsecs (pc) per arcsecond. Its relative closeness makes NGC 4151 an important laboratory for the detailed study of the feeding and feedback processes of its active nucleus. In optical wavelengths, the emitting gas of the narrowline region (NLR) has been found to have an approximate biconical morphology, as observed in a previous Hubble Space Telescope (HST) [OIII] 5007 narrow-band image, which is shown in the bottom of Figure 1. According to previous studies, our line of sight is outside of, but close to, the edge of the cones oriented along position angle (PA) approx. 60deg. Optical spectroscopy reveals outflows along the cones with the approaching side to the southwest. In the radio, it presents a linear structure along  $PA = 77^\circ$ , which is not aligned with the bicone. Although NGC 4151 has been the subject of many previous imaging and spectroscopic studies, we used the Near-infrared Integral Field Spectrometer (NIFS) at the Gemini North telescope to obtain an unprecedented '3-D view' of the galaxy's NLR which allows us to map its excitation and kinematics. The high image quality of NIFS revealed details with a spatial resolution comparable to that of HST, and the spectral resolution provided by NIFS allowed the construction of channel maps along emission-line profiles providing a 'kinematic tomography' of the NLR which challenges previous kinematic models of the source.

Author

*Seyfert Galaxies; Active Galactic Nuclei; Imaging Techniques; Spatial Resolution; Line of Sight; Excitation; Spectral Resolution*



**20090035778** Gemini Observatory, Hilo, HI, USA

#### **Recent Science Highlights**

Roy, Jean-Rene; Fisher, R. Scott; Gemini Focus: Newsletter of the Gemini Observatory; June 2009, pp. 55-60; In English; See also [20090035776](#); Copyright; Avail.: Other Sources

Highlights include: A freaky cosmic dwarf pair, Betelgeuse and VY canis as future supernovae, the return of McNeil's nebula, A naked-eye gamma ray burst, a cool dwarf in aquarius, disappearing supernova stars, and absence of lithium-6 in exoplanet host stars.

Author

*Extrasolar Planets; Gamma Ray Bursts; Supernovae*

**20090035779** British Columbia Univ., Vancouver, British Columbia, Canada

#### **When Gemini Came Into Focus: The November 29, 1990, Oxford Science Meeting**

Walker, Gordon A. H.; Gemini Focus: Newsletter of the Gemini Observatory; June 2009, pp. 42-43; In English; See also [20090035776](#); Copyright; Avail.: Other Sources

The first-ever Scientific Advisory Committee (SAC) meeting for the twin 8-meter telescopes project, then known as LT (for Large Telescope, Gemini was adopted two months later) began on a cold, grey, damp morning in the Nuclear and Astrophysics Laboratory, Oxford, U.K. (see Figure 1). A session in early September 1990 at the Dominion Astrophysical Observatory in Victoria, British Columbia had been largely devoted to attempting to divide the engineering effort between the partners, but it had also charged the SAC to establish firm performance specifications for the engineers. In the U.S., the project was essentially the responsibility of the Association of Universities for Research in Astronomy (AURA). Pat Osmer was overall project scientist (PS), and he came to Oxford with Richard Green, the U.S. project scientist, Fred Gillett, and Bob Schommer (of Cerro Tololo Inter-American Observatory (CTIO)). I attended as the Canadian project scientist and Ren Racine was the other Canadian present. Roger Davies was the U.K. project scientist and attended with Pat Roche, Richard Ellis, and Ian Parry. Also from the U.K. was Keith Raybould, who was considering 8-meter telescope designs and who would go on to be a key player in the success of Gemini. Richard Bingham and Pat Wallace were also there, along with Matt Mountain who had come from Royal Observatory Edinburgh to talk about infrared spectrographs. We were not alone! There was more than one elephant in the room. Keck had achieved first light just a few days earlier with nine of their 36 mirror segments (full first light would not be achieved until April 1992). The U.S. National Science Foundation (NSF) wanted to know why we would not simply adopt the 'proven' Keck segmented 10-meter design and thereby save both time and possibly money. As NSF was the only one with any large telescope funds, they were quite entitled to ask that question. In the October 1990 Congressional markup, \$4 million (U.S.) had been set aside for large telescope engineering studies and the purchase of glass, provided there was a satisfactory 50:50 cost sharing between the U.S. on the one part and the U.K. and Canada on the other. Otherwise, there was only \$2 million and a cap of \$88 million for a single Northern Hemisphere telescope. While there was priority in the U.K. for a large telescope, their senior committee had yet to decide between the U.S.-U.K.-Canada collaboration or one with Spain on La Palma. A decision was expected in December 1990 (but that didn't happen). The Hubble Space Telescope, launched six months earlier, was too bleary-eyed from spherical aberration yet to set it apart in optical resolution, but it remained a potential competitor for imaging (correcting optics were installed three years later in December 1993).

Author

*Imaging Techniques; Observatories; Telescopes; Astrophysics; Spectrographs; Infrared Radiation; Hubble Space Telescope; Functional Design Specifications*

**20090035780** Gemini Observatory, Hilo, HI, USA

#### **What Does 2009 Teach Us?**

Roy, Jean-Rene; Gemini Focus: Newsletter of the Gemini Observatory; June 2009, pp. 7-11; In English; See also [20090035776](#); Copyright; Avail.: Other Sources

As so many of us have experienced while giving public talks and participating in 'debates' about astronomy and science, presenting the modern science view is always well-received by our audiences. However, there are always a few speaking aloud, on behalf of many, who say: 'Your arguments are very convincing, but I still do not believe you!' '2009' invites us, scientists, historians, and scholars, to interrogate ourselves on the challenge of sharing knowledge and understanding our universe as we pile up dazzling discoveries. Are we in the danger of running ahead of ourselves in promoting new efforts to push the frontiers of knowledge faster? Are we putting ourselves at risk in proposing to build newer, more powerful and very costly facilities to explore a universe that a majority of tax-payers refuse to accept. Should we direct our efforts to address their unfounded beliefs? Should we just ignore them? Underlying Darwin's model are the eons of time needed to produce the millions of species and their complexity seen today on Earth. Darwin's requirement of half a billion years put him in head-on

confrontation with the physicists of his time who proposed a short 20 to 40 million years for the age of the Earth. To use the expression of American geologist and historian Martin J. S. Rudwick, Galileo burst the limits of space and Darwin burst the limits of time. However, these incommensurable scales of space and time are not what disturb people so much in their views of the universe and mankind's place in it. It is the role of chance in the organization of the universe, in the formation of our solar system, and of the Earth, and as the driving mechanism of the evolution of life that rocks their 'beliefs.' Wilson put his finger on it when he wrote, 'Evolution in a pure Darwinian world has no goal or purpose: the exclusive driving force is random mutations sorted by natural selection from one generation to the next.' This is the 'hard nut' we have to crack. The concept of chance or randomness transformed modern physics and chemistry through statistical mechanics in the late 19th century and the more fundamental step of quantum mechanics in the early 20th century. Amazingly, the underlying role of randomness in nature was implanted more than 2,000 years ago: yes, the clinamen of the early atomists. Then, as today, this unsettling fact and idea was strongly resisted. It is still considered profoundly repulsive to so many of our fellow citizens. This is our challenge.

Author

*Biological Evolution; Galileo Spacecraft; Geological Surveys; Quantum Mechanics; Statistical Mechanics; Geology*

**20090035781** Herzberg Inst. of Astrophysics, Ottawa, Ontario, Canada

### **An Exoplanet Family Portrait**

Marois, Christian; Gemini Focus: Newsletter of the Gemini Observatory; June 2009, pp. 44-47; In English; See also [20090035776](#); Copyright; Avail.: Other Sources

What do planets around other stars look like? This question is driving an exciting quest to take pictures of exoplanets. This is challenging work. Until recently, surveys using direct imaging have uncovered only a few candidate worlds—even after much intense effort. These possible planets have been found in systems that are unlike our own in many ways. In addition, there is usually only one candidate world orbiting its parent star, and often it lies at a very wide separation (or distance) of more than 100 astronomical units (AU). Our team used the Gemini Observatory to capture a spectacular image showing not one, not two, but three planets in orbit around the star HR 8799. They lie at distances similar to those of the outer planets of our solar system. This is the first image of a multi-planet system, and these exoplanets are also the first at separations similar to Uranus and Neptune (which orbit the Sun at 20 and 30 AU, respectively) to be discovered by any means. The near-infrared K-band (2.2-micron) image of the planetary system (Figure 1) was obtained using the Gemini North telescope, the Altair adaptive optics system, and the Near Infrared-imager and Spectrometer (NIRI). The three planets were found using the 'Angular Differential Imaging' or ADI observing technique, which works as follows: after correcting for most of the turbulence in Earth's atmosphere with an adaptive optics system (like the National Research Council Canada Herzberg Institute of Astrophysics (NRC-HIA) Altair system used on Gemini North), the major component of residual 'noise' in the image is stellar light scattered by surface irregularities from the telescope and instrument mirrors and lenses. This residual noise, because of its origin, has a fixed pattern with respect to the telescope and camera orientation. To separate out any possible planets from scattered starlight, the ADI technique relies on the slow rotation of the field of view (induced by the motion of the Earth) that occurs during tracking with an altitude/azimuth telescope. While guiding on the star to keep it registered at the detector's center, the planets appear to slowly revolve around the star and against the fixed pattern of stellar scattered light due to the field rotation. Computer software is then used to analyze a sequence of many images and subtract the scattered stellar halo and reveal any previously undetected nearby faint objects. The overall contrast gain with ADI is a factor of 10-100.

Author

*Astrophysics; Extrasolar Planets; Adaptive Optics; Field of View; Surface Defects; Observatories; Near Infrared Radiation*

**20090035782** Hawaii Univ., HI, USA

### **The Quest for Other Worlds: The Gemini NICI Planet-finding Campaign**

Liu, Michael; Gemini Focus: Newsletter of the Gemini Observatory; June 2009, pp. 61-66; In English; See also [20090035776](#); Copyright; Avail.: Other Sources

On-telescope commissioning of NICI for methane differential imaging was completed in 2008, with the Gemini Observatory staff and campaign team working closely together to fully test instrument operation, develop observing techniques, and assess on-sky performance. NICI commissioning data, taken for stars over a wide range in brightness and seeing conditions, were used to refine the campaign simulations and planning. Overall, though work is still ongoing to fully characterize NICI performance, the instrument appears to perform better than any other existing AO instrument for the detection of faint companions inside a radius of about two arcseconds. The first NICI science run was in December 2008, and since then campaign observations have been carried out monthly during bright time around full Moon. Campaign members

have gone to Chile to participate in the commissioning and science runs, and most recently, the team has effectively participated remotely (via videoconferencing, see Figure 2). The Gemini queue system has been a major advantage for this work, since campaign observations are carried out only during suitable seeing conditions. At other times, regular Gemini queue programs well matched to poorer seeing conditions are executed. Following one more science run in April 2009, NICI will be removed from the telescope in May for maintenance and minor upgrades. This is well-timed, since the weather conditions during the Chilean winter are typically unsuitable for NICI observing. The campaign team plans to ultimately observe about 300 carefully selected stars. As of the end of the summer 2009 observing season (which happens in April at Gemini South), about 120 targets have been observed, with the data processed by our team's pipeline that has been custom-tailored for NICI's unique datasets. While some potentially interesting candidates have been found in the initial set of data (i.e., very faint objects next to the much brighter science targets), the final confirmation that they are real exoplanets, as opposed to background objects, will come with second epoch follow-up check for common proper motion. If confirmed, multi-band imaging data from NICI, and perhaps integral field spectroscopy from other AO-equipped telescopes, will allow us to study the spectra of these young exoplanets. Spectral information from exoplanets is critical for the characterization of the compositions, temperatures, and masses of these worlds. Determining the visible history of extrasolar planets will ultimately help us better understand our own place in the universe.

Author

*Extrasolar Planets; Imaging Techniques; Observatories; Faint Objects*

**20090035783** Gemini Observatory, Hilo, HI, USA

### **Creating a More Perfect Machine**

Michaud, Peter; Gemini Focus: Newsletter of the Gemini Observatory; June 2009, pp. 33-41; In English; See also [20090035776](#); Copyright; Avail.: Other Sources

Four hundred years ago, one man fashioned a simple telescope from two small pieces of glass. Using this new invention, Galileo Galilei was able to set humanity on an irreversible course of exploration unparalleled in the history of science. (see article in this issue starting on page 7.) As the 20th century came to a close, the generations of telescopes built since Galileo's have culminated in giant 8- to 10-meter optical/infrared light collectors perched on remote mountaintops across the globe. The contrast between Galileo's simple telescope and today's super-sized instruments couldn't be more profound. Where Galileo worked essentially alone and pointed his telescope with a simple nudge, today's telescopes require teams of engineers, scientists, and support staff to maintain and operate the multi-story-high harvesters of light that are aimed with nearly infinitesimal precision. The design and building of the twin Gemini 8-meter telescopes consumed the energies of hundreds of individuals who were committed to revolutionary new ideas and approaches that define the current generation of large telescopes. Unlike the instruments of past generations, Gemini and other large facilities were built by teams of engineers who excelled at managing large complex projects. They worked in concert with scientists from around the world to create ever more perfect machines. This article follows in the spirit of the profiles already presented in this issue of GeminiFocus and continues the story of Gemini's design, development, and construction from the point of view of five of Gemini's most influential 'creators' (see interviewees' bios throughout this article). Like everyone profiled in this issue, all five of these creators are quick to point out that what they did to build Gemini represents the work of a remarkable team, a team that, in the words of Rick McGonigal, '...was one of the better teams I ever worked on, in terms of everybody being willing to step up and help out or give something to the other guy.'

Author

*Galileo Spacecraft; Spaceborne Telescopes; Infrared Radiation; Accumulators; Aerosols*

**20090035784** California Inst. of Tech., Pasadena, CA, USA

### **Unveiling Galaxy Bulge Formation with Long-slit Spectroscopy**

MacArthur, Lauren; Gemini Focus: Newsletter of the Gemini Observatory; June 2009, pp. 48-50; In English; See also [20090035776](#); Copyright; Avail.: Other Sources

In the context of the currently favored cosmological  $\Lambda$ -Cold Dark Matter ( $\Lambda$ CDM) model of our universe, the formation and evolution of galaxies remains a major unsolved problem. In particular, the detailed evolution of the bulge and disk components of spiral galaxies is not well represented in current simulations. The data-model discrepancies do not necessarily reflect a failure in the  $\Lambda$ CDM model, but may indicate physical regimes and processes that are either poorly understood or difficult to implement in large simulations. Given the significant challenges faced by current galaxy formation models, guidance towards a true understanding of disk galaxies must come from an observational perspective. Since the mid-1990s, an observational picture has been emerging whereby the dominant bulges of early-type spirals were formed in a manner similar to pure elliptical galaxies, i.e., through violent and rapid processes such as monolithic collapse or major mergers,

whereas the smaller bulges of late-type spirals were formed ‘secularly,’ though an internal redistribution of the disk material. However, a clear-cut distinction between formation scenarios remains uncertain.

Author

*Galactic Bulge; Disk Galaxies; Elliptical Galaxies; Cosmology; Spectroscopy; Spiral Galaxies; Galactic Evolution*

**20090035785** Gemini Observatory, Hilo, HI, USA

#### **Instrumentation Update**

Jensen, Joe; Gemini Focus: Newsletter of the Gemini Observatory; June 2009, pp. 67-71; In English; See also [20090035776](#); Copyright; Avail.: Other Sources

To fulfill its mission to explore the universe and share its wonders, Gemini Observatory must upgrade and expand the suite of instrumentation that translates photons collected by our fantastic telescopes into meaningful observations. Since my report in the last issue of GeminiFocus (December 2008), Gemini's instrument building teams have made significant progress on a number of fronts. Gemini is on the verge of vastly improving its capabilities, both in the north and in the south. We will soon have an upgraded GMOS at Gemini North with significantly better performance than the current version. We will have a rebuilt GNIRS providing moderate to high resolution spectra from 1 to 5 microns. These improvements will complement the existing capabilities, including near-infrared imaging being delivered routinely by NIRI now (with and without Altair laser guide star AO), and the excellent thermal-infrared performance being delivered by Gemini's world-leading protected silver mirror coatings and the MICHELLE spectrograph. NIFS rounds out the Gemini North complement with 1- to 2.5-micron AO integral field spectroscopy with very high spatial resolution. T-ReCS continues to perform well at thermal-infrared wavelengths to complement MICHELLE in the north. Finally, the incredible performance expected with the new Gemini Multi-conjugate AO system (GeMS, see update starting on next page) will be commissioned later in 2009, as soon as the laser system is delivered. GeMS will feed FLAMINGOS-2 and the Gemini South AO Imager (GSAOI) with a 2 square-arcmin AO-corrected field of view with stable, uniform images. GeMS will be the first laser MCAO system deployed, and it will enable a wide range of new science that depends on the best possible images over a wide field of view. It is a very exciting time to be working at the Gemini Observatory. The new and improved instruments coming online this year promise to allow our astronomical community to make exciting discoveries that will revolutionize our understanding of the universe.

Author

*Imaging Techniques; Near Infrared Radiation; Spectrographs; Telescopes; Observatories; Astronomy; Field of View; Temperature Effects*

**20090035825** NASA Ames Research Center, Moffett Field, CA, USA

#### **Kepler Data Validation and Follow-up Programs**

William, Borucki J.; February 02, 2009; 1 pp.; In English; CoRoT International Symposium, 2-9 Feb. 2009, Paris, France Contract(s)/Grant(s): WBS 354171.04.01.01

Report No.(s): ARC-E-DAA-TN388; No Copyright; Avail.: Other Sources; Abstract Only

The approach that the Kepler Mission uses to remove false positive events and to validate the discoveries consists of two parts; data validation (DPI) and follow up observations program (FOP). DV consists of several methods of examining the data from the spacecraft observations. First, to rule out statistical fluctuations in the data, accept only signals that show 3 or more transits and that have a total signal-to-noise ratio that exceeds 7 sigma. Second, to identify small stellar companions to the target star, we check for secondary eclipses and determine if the transit characteristics are appropriate for a planetary companion. Third, check for background binaries that are in the target aperture. Here we measure the movement of the image centroid before, during, and after the transit. If the target is producing the signal, a dimming will move the image centroid in a known direction and magnitude. If the signal comes from a nearby star, the amplitude and direction of the motion will be different. This test is expected to rule out the hundreds of binary signals expected from background stars. The precision of the measurement depends on the stellar fluxes and positions but can be better than 0.01 pixel; i.e., 0.04'. Those candidates that pass these tests are examined using ground-based telescopes and radial velocity spectrometers. First medium precision RV is used to rule out any remaining stellar companions. Then high spatial resolution imaging is used to check for nearby stars that are in the aperture- (The Kepler apertures depend on magnitude but are of order 36 sq arc sec in area.) If no stars are present that could generate the observed signal, then the candidate goes to a large telescope such as Keck, HET, or William Herschel for high precision observations to get the planet mass or an upper limit to it, if there are some stars in the aperture, then the photometric observations are employed to look for the transit by canceling out the confounding stars. If none are seen, then the candidate is sent to a large telescope such as Keck

Author

*Kepler Mission; Centroids; Signal to Noise Ratios; Satellite Observation; A Stars; High Resolution; Radial Velocity; Spatial Resolution; Targets*



**20090036338** Maryland Univ. Baltimore County, Baltimore, MD, USA

**The Variable X-Ray Spectrum of Markarian 766. II. Time-resolved Spectroscopy**

Turner, T. J.; Miller, L.; Reeves, J. N.; Kraemer, S. B.; [2007]; 1 pp.; In English

Contract(s)/Grant(s): NNX07AM26G; Copyright; Avail.: Other Sources

ONLINE: <http://dx.doi.org/10.1051/0004-6361:20077947>

Time-resolved spectroscopy, slicing XMM and Suzaku data down to 25 ks elements was used to investigate whether absorption or scattering components dominate the spectral variations in Mrk 766. Results: Time-resolved spectroscopy confirmed that spectral variability in Mrk 766 can be explained by either of two interpretations of principal components analysis. Detailed investigation confirmed that rapid changes in the relative strengths of scattered and direct emission or rapid changes in absorber covering fraction provide good explanations of most of the spectral variability. However, a strong correlation between the 6.97 keV absorption line and primary continuum together with rapid opacity changes showed that variations in a complex and multi-layered absorber, most likely a disk wind, are the dominant source of spectral variability in Mrk 766.

Author

*Markarian Galaxies; Spectroscopy; X Ray Spectra; XMM-Newton Telescope*

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**LUNAR AND PLANETARY SCIENCE AND EXPLORATION**

Includes planetology; selenology; meteorites; comets; and manned and unmanned planetary and lunar flights. For spacecraft design or space stations see *18 Spacecraft Design, Testing and Performance*.

**20090035582** NASA Johnson Space Center, Houston, TX, USA

**Lunar Lava Tubes - The Promise of New Orbital Data**

Allen, Carlton C.; October 18, 2009; 1 pp.; In English; Geological Society of America Annual Meeting, 18-21 Oct. 2009, Portland, OR, USA

Report No.(s): JSC-CN-18936; No Copyright; Avail.: Other Sources; Abstract Only

The basaltic plains of the Moon contain lava channels on scales of tens of meters to hundreds of kilometers. Many of these channels are segmented, strongly suggesting that some portions include covered lava tubes. Lunar lava tubes are expected to provide unique environments below the harsh lunar surface, maintaining near-isothermal conditions and substantial shielding from solar and galactic radiation. A lava tube has often been suggested as natural shelter for a future human outpost. Previous searches for lunar lava tubes have been limited by a combination of image resolution and completeness of coverage. The five robotic Lunar Orbiter spacecraft combined to photograph essentially the entire lunar surface with a resolution of 60 m, and covered selected sites with resolutions as high as 2 m. The highest-resolution Apollo images, from the mapping and panoramic cameras, covered swaths totaling 16% of the lunar surface, at resolutions of approximately 5 m. The Lunar Reconnaissance Orbiter -- launched in June 2009 to a polar orbit -- carries a suite of instruments that will revolutionize lunar remote sensing, including the identification and characterization of lava tubes. The Lunar Reconnaissance Orbiter Camera (LROC) system includes a multi-spectral wide-angle camera with a resolution of 70 m, allowing a comprehensive survey of the entire lunar surface. The LROC narrow-angle camera is providing targeted images at resolutions of 0.5 - 2 m, including stereo coverage, which should allow detection of tube entrances and breakdown structures. The Lunar Orbiter Laser Altimeter is producing a global topographic map with a vertical resolution of 1 m and a horizontal resolution of 50 m. These data will be critical to understanding lava dynamics and tube emplacement.

Author

*Basalt; Lava; Remote Sensing; Reconnaissance; Solar Radiation; Laser Altimeters; Lunar Orbiter; Shielding*

**20090035736** Jet Propulsion Lab., California Inst. of Tech., Pasadena, CA, USA

**Anomaly Trends for Missions to Mars: Mars Global Surveyor and Mars Odyssey**

Green, Nelson W.; Hoffman, Alan R.; January 07, 2008; In English; 46th AIAA Aerospace Sciences Meeting and Exhibit, 7-10 Jan. 2008, Reno, NV, USA; Original contains color illustrations; Copyright; Avail.: Other Sources

ONLINE: <http://hdl.handle.net/2014/41381>

The long term flight operations of the Mars Global Surveyor and Mars Odyssey spacecraft give us an excellent chance to examine the operations of two long lived spacecraft in orbit around Mars during overlapping time periods. This study examined the anomalies for each mission maintained for NASA at the Jet Propulsion Laboratory. By examining the anomalies each mission encountered during their multiyear missions, trends were identified related to when anomalies occurred during



each mission, the types of anomalies encountered, and corrective actions taken to mitigate the effects of the anomalies. As has been discovered in previous studies the numbers of anomalies directly correlate with mission activity and show a decreasing trend with elapsed mission time. Trend analysis also identified a heavy emphasis on software as the source or solution to anomalies for both missions.

Author

*Mars Global Surveyor; 2001 Mars Odyssey; Anomalies; Flight Operations; Spacecraft Orbits; Mars Missions*

**20090036337** Boeing Co., Seattle, WA, USA

**Cumulative Damage in Strength-Dominated Collisions of Rocky Asteroids: Rubble Piles and Brick Piles**

Housen, Kevin; [2009]; 12 pp.; In English; Original contains color and black and white illustrations

Contract(s)/Grant(s): NNH05CC23C; Copyright; Avail.: Other Sources

ONLINE: <http://dx.doi.org/10.1016/j.pss.2008.07.006>

Laboratory impact experiments were performed to investigate the conditions that produce large-scale damage in rock targets. Aluminum cylinders (6.3 mm diameter) impacted basalt cylinders (69 mm diameter) at speeds ranging from 0.7 to 2.0 km/s. Diagnostics included measurements of the largest fragment mass, velocities of the largest remnant and large fragments ejected from the periphery of the target, and X-ray computed tomography imaging to inspect some of the impacted targets for internal damage. Significant damage to the target occurred when the kinetic energy per unit target mass exceeded roughly 1/4 of the energy required for catastrophic shattering (where the target is reduced to one-half its original mass). Scaling laws based on a rate-dependent strength were developed that provide a basis for extrapolating the results to larger strength-dominated collisions. The threshold specific energy for widespread damage was found to scale with event size in the same manner as that for catastrophic shattering. Therefore, the factor of four difference between the two thresholds observed in the lab also applies to larger collisions. The scaling laws showed that for a sequence of collisions that are similar in that they produce the same ratio of largest fragment mass to original target mass, the fragment velocities decrease with increasing event size. As a result, rocky asteroids a couple hundred meters in diameter should retain their large ejecta fragments in a jumbled rubble-pile state. For somewhat larger bodies, the ejection velocities are sufficiently low that large fragments are essentially retained in place, possibly forming ordered 'brick-pile' structures.

Author

*Cumulative Damage; Fragmentation; Asteroid Collisions; Catastrophe Theory*

## 92

### SOLAR PHYSICS

Includes solar activity, solar flares, solar radiation and sunspots. For related information see *93 Space Radiation*.

**20090035801** NASA Langley Research Center, Hampton, VA, USA

**Technical Note: A Time-Dependent I(sub 0) Correction for Solar Occultation Instruments**

Burton, Sharon P.; Thomason, Larry W.; Zawodny, Joseph M.; May 28, 2009; 21 pp.; In English; Original contains color and black and white illustrations

Contract(s)/Grant(s): WBS 479717.02.01.01.38

Report No.(s): LF99-8909; Copyright; Avail.: CASI: [A03](#), Hardcopy

ONLINE: <http://hdl.handle.net/2060/20090035801>

Solar occultation has proven to be a reliable technique for the measurement of atmospheric constituents in the stratosphere. NASA's Stratospheric Aerosol and Gas Experiments (SAGE, SAGE II, and SAGE III) together have provided over 25 years of quality solar occultation data, a data record which has been an important resource for the scientific exploration of atmospheric composition and climate change. Herein, we describe an improvement to the processing of SAGE data that corrects for a previously uncorrected short-term timedependence in the calibration function. The variability relates to the apparent rotation of the scanning track with respect to the face of the sun due to the motion of the satellite. Correcting for this effect results in a decrease in the measurement noise in the Level 1 line-of-sight optical depth measurements of approximately 40% in the middle and upper stratospheric SAGE II and III where it has been applied. The technique is potentially useful for any scanning solar occultation instrument, and suggests further improvement for future occultation measurements if a full disk imaging system can be included.

Author

*Occultation; Solar Instruments; Sun; Time Dependence; SAGE Satellite*

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